GEORGE STEPHENSON

BY

RUTH MAXWELL M. A.

WITH EIGHT ILLUSTRATIONS

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CHAPTER I: *Childhood*

GEORGE STEPHENSON was born on the 9th of June, 1781, in the colliery village of Wylam, about eight miles west of Newcastle. His parents, Robert and Mabel Stephenson—or Steveson, as they themselves pronounced the name—were then living in a part of a small detached cottage, standing on the high road (the old posting road) between Newcastle and Hexham. It was known at one time as High Street House. Despite this somewhat grand-sounding name, the house was in reality a very humble abode, consisting of four separate single roomed dwellings.

The lower room in the west end was that occupied by Robert Stephenson. This single room, with its clay floor and raftered ceiling, had to serve the whole family as kitchen, scullery, bedroom, and parlour. At the time of George's birth, however, there was only one other child, James, then a little over two years of age.

Robert Stephenson, the father, was a gentle, affectionate man, hard-working though not physically robust. His work was that of fireman at the colliery. His greatest accomplishment was that of telling stories—a gift not to be despised in those days when few working men could read—and he could not only retail the old favourites, such as Sinbad the Sailor, but even weave new romances of his

own. Perhaps the power of story-telling grew in part out of the wish to entertain the children of the village, for strongest of all his characteristics was his love of all young creatures, human and animal alike. This trait he bequeathed in full to his second son, and it was not the least part of George's fine inheritance. In summer he would take his little sons with him bird-nesting, and George remembered to the end of his life his first sight of a blackbird's nest, when as a tiny boy he was held up in his father's arms that he might look at the nestlings.

The Stephensons remained at Wylam until George was eight, when, the coal in that particular seam being worked out, the collier had to 'follow the wark' to a new pit. By this time George had a sister, Eleanor, two years younger than himself, and two little brothers, Robert and John. His other sister, Ann, was born three years later.

This removal and another which succeeded it when George was about fourteen, took the family only a few miles away and gave Robert Stephenson a change merely of environment, not of status. He remained a fireman, still earning only twelve shillings a week. It can be imagined readily enough that the family of seven or eight must have had a hard struggle at times to find the wherewithal even for food and clothing. There was no school for the children to attend, but even had one existed their parents could never have paid the fees —indeed, even a free school would not have

availed them, for as soon as the little boys were old enough they had perforce to seek some employment that would add, by however trifling an amount, to so slender an income.

The two elder boys could make themselves useful, even as very little children, by carrying their father's dinner, and by taking care of their younger brother and sisters. In particular the babies had to be kept out of the way of the coal-wagons, which were dragged by horses along a wooden railway, the use of steam for such a purpose being still undreamed of.

On leaving Wylam the Stephensons went to live in a one-roomed cottage at Dewley Burn, a tiny hamlet situated, as the name implies, on the banks of a burn or stream. Soon after they had settled there George found his first paid employment. A widow, Grace Ainslie, who lived near, wanted a boy to herd her cows and keep them from being run over by the coal-wagons, and 'Geordie Steve' was very proud when she chose him for the work, at a wage of twopence a day.

His duties were not too exacting, and left him plenty of time for play in the lanes or by the side of the stream, where he set up toy water-mills. He and his friend Tom Thirlaway spent many hours making engines out of the clay which they dug from the Dewley bog, giving them pipes made of hemlock stems.

A little later, George was earning fourpence a day by hoeing turnips and leading horses at the plough. He was still a little fellow, and already showed his courage and determination

in the cheerfulness with which he started off alone at dawn, blowing on his fingers to keep them warm.

His brother James was by this time employed at the colliery as a 'picker,' his work being to free the coal from stones and dross, and George presently attained his great wish, and was taken as picker also, at sixpence a day.

He never halted in his steady rise. Soon he was driving the 'gin-horse,' first at Dewley and then at Black Callerton Colliery, two miles away. The two-mile walk twice a day, in the early morning and late evening, was no obstacle to him, for he was strong and eager. The 'gin' was a large drum-shaped contrivance, placed horizontally, and having ropes wound round it, by means of which the baskets or 'corves' used for the coal could be drawn up and down. It was worked by a horse which walked round and round a circular track known as the 'gin-race.' As gin-horse driver George earned eightpence a day.

All this time he was rising nearer and nearer to the desire of his heart, that he might become an engine-man, and at fourteen he was made assistant fireman to his father. It was a proud moment when he went home to tell his mother of this fresh promotion, and of his increased wages, now a shilling a day.

He sometimes managed to earn an extra penny or two by other means. Once he went to Newcastle with his sister Eleanor, who

wanted to buy a bonnet. After much gazing she espied a 'chip' which took her fancy, but alas!—it cost fifteenpence more than all Nell's money. She came sadly out of the shop, sure that no other bonnet could ever suit her half so well.

But George was seldom without resource, and presently he said: "Never heed, Nell; come wi' me, and I'll see if I canna win siller enough to buy the bonnet; stand ye there till I come back." He ran off, and Nell dried her tears and stood waiting in the market-place. At first she was interested in watching the market people and the crowd of buyers, but when evening fell and the crowd had gone she grew chilly and tired, and was beginning to wonder if Geordie had met with some accident, when he came running up to her, panting out triumphantly, "I've gotten the siller for the bonnet, Nell!" "Eh, Geordie!" she cried admiringly, "but hoo hae ye gotten it?" "Haudin" the gentlemen's horses!" he answered, and they hastened gleefully to buy the bonnet.

CHAPTER II : *Boyhood and Youth*

THE Stephensons now removed again, to Jolly's Close, another small hamlet, where the miners received their cottages rent-free as part of their wages.

James was also by this time an assistant fireman, and the two younger boys were pickers, so that although the family still lived in a single room, they were much better off than in George's early childhood.

The father and sons together now earned sometimes as much as £2 a week. But we have only to consider the conditions of social life for the working classes of England at that period (1795) in order to realize that £2 a week would not go very far, and would purchase merely the bare necessities of life. The war with Napoleon brought, as its necessary consequences, fluctuations in trade, high taxes, the burden of which fell heavily on the labouring part of the population, a lack of many articles of food, and greatly inflated prices for such as were to be had. The Act of 1791 had aimed at regulating the price of wheat at about 50 shillings a quarter, but after 1795 it rose steadily and swiftly, until by the end of 1800 it had reached 130s. a quarter. Riots took place occasionally, but the

overburdened poor had few constitutional means of obtaining redress.

Still, the Stephensons were more comfortably off than many of their fellow-labourers, for they were all sober and industrious, and the mother was a careful, 'canny' housewife.

Although George Stephenson worked hard and long, he still managed to find time for recreation. He was big and strong for his age, and delighted in feats of strength; in throwing the hammer and in lifting heavy weights he could excel any of his companions. The son of Robert Stephenson could hardly have been anything but genial and friendly, and the neighbours described George afterward as "full of fun and tricks." He showed at this time as always his love of animals, and more especially of birds. Much of his spare time was spent bird-nesting, and he used to tame the young birds and make them so confiding that they would stay in the house uncaged. For some years he had a tame blackbird which lived in the cottage during the winter, flying away in the spring to pair and nest, and returning with the darkening days. The power of treating birds so gently that they did not fear him was inherited or learnt from his father, round whose engine fire the robins gathered for crumbs as the children gathered for stories.

When George was fifteen he and his 'mate,' Bill Coe, were sent to work an engine together at Throckleybridge, and there George was told one Saturday night that his wages were

raised to 12s. a week. Overjoyed, he rushed out exclaiming, "I am now a made man for life!"

Shortly after this a new pit was sunk at Wylam, and Robert Stephenson was made fireman of the new engine, with George as engine-man. Thus at the age of seventeen George had fulfilled his great ambition. Their positions were now reversed, Robert being his son's assistant, and the sweetness and generosity of the older man's nature were truly shown in the ungrudging pride he took in George's success.

The engine-man has to watch his engine constantly, and if for any reason it is not working perfectly, to put it right, or if that be beyond his power, to summon the chief engineer for the purpose.

One of the well-known arguments in favour of division of labour is that if a man has one special piece of work to do, he will devote all his attention to that, and by thinking exclusively of the one operation will possibly find a quicker or more effectual way of performing it. Perhaps in this way mechanical devices may be invented for achieving what previously had been done laboriously by hand.

George Stephenson watched his engine day by day and hour by hour, until every detail of its working was thoroughly familiar to him and the remedy for any possible defect was ready in his mind. But it was not as a mere mechanism that he thought of it, but rather in the way that a good captain thinks

of his ship, almost as a living creature, and with the affection that genuine understanding always brings.

He was still fond of making clay models of engines, but he could model only those which he had seen or which some friend had described to him. Vague rumours had reached him of other and better engines, about which books had been written. But books were of no use to George Stephenson, for though he was over eighteen, he had never learned to read. This was no slur on his ability—few of the miners of his time were able to read, and not many of them ever had the wish to do so. Their work was hard and monotonous, and when a holiday did come, naturally enough they demanded some more exciting pleasure than poring over a book. Unfortunately there were few pleasures to be had, and the cruel one of cockfighting was the most popular.

Occasionally one of George's companions who could read would bring a book or old newspaper and read aloud to the other miners, and this was the only means by which they could learn anything of passing events, great as the events of those years were, when Napoleon was almost at the height of his power.

The desire to learn more about his beloved engine, however, was a powerful stimulus, and George determined to remain ignorant no longer. Accordingly he began to go three nights a week to a night-school in a neighbouring village, where he had his first lessons

in reading and writing from Robin Cowens. For these he gladly paid the small fee, threepence a week, and he speedily acquired such knowledge as his teacher could give him. Presently a better school was started by a Scotchman named Andrew Robertson, and Stephenson began to attend this, partly because it was nearer his home, and partly because he had heard that the new schoolmaster could teach arithmetic, of which George was anxious to learn something. This was a subject well suited to the bent of his mind, and his rapid progress was the pride of his master and the marvel of his comrade Robert Gray, who "could not make out how George got on so fast, he took to figures so wonderful." The fees of the newschool were fourpence a week.

At the end of the evening's lesson Andrew Robertson would set fresh sums on the slate, which Geogre would work out next day in his spare time. Cock-fighting had no attraction for him, for he loved animals too well to take pleasure in seeing them baited and hurt, and the temptation of drink was one which he steadily resisted. His clean and ardent mind found early the pure and lasting pleasure of the search after knowledge, and some of his happiest hours were spent sitting over his engine fire with his slate, while his little friends the robins hopped round him, pecking at the crumbs he had strewn for them. He was still as fond of birds as ever. About this time he tried an experiment in hatching eggs artificially

by means of a rough attempt at what would now be called an incubator. He was not successful, but the attempt shows his liking for practical experiments of all kinds.

Animals as well as birds readily became attached to him. He was very proud of a dog which brougt his dinner every day in a tin fastened round its neck. It was attacked one day by a bigger dog, which it boldly fought and conquered, arriving at the pit a little later than usual, with the tin can still attached to its collar, confidently expecting its master's praise, which was given heartily, though the dinner had been spilt during the combat.

For some time George had been desirous of learning the art of braking engines, for the position of brakesman was a good one, and commanded high wages. The brakesman had charge of the engine that drew coal from the pit. The coal was drawn up in large hazel-wood baskets, or corves, placed in a cage. When the cage was approaching the pit-head a bell sounded, and the brakesman had to check the speed by placing his foot on the board attached to a wooden brake. This acted on the fly-wheel of the engine, and instantly stopped the cage. The coal was taken out, and the brakesman then sent down the empty corves.

Stephenson had confided his ambition to his old comrade Bill Coe, and when Coe was made brakesman he took every opportunity of teaching Stephenson how to do the work, and

also of letting him practise on the brake in his charge. Some of the other workmen objected to this, and one of them stopped the engine, and in consequence the working of the whole pit, as a protest against Stephenson's being allowed to brake. One day, however, when the manager of the pit was at hand, Coe purposely called in his friend to brake, the engine was stopped as usual, and the manager, on learning the reason, put a stop to the opposition; and despite the gibes at his clumsiness George succeeded in learning the work. The older men's jealousy is easy to understand, since Stephenson was considerably younger than most brakesmen; still, he had only seized a fair opportunity for advancement.

CHAPTER III : *Hard Times*

IN 1801, when Stephenson was twenty years old, he and Coe were sent to Black Callerton Colliery, and Stephenson was appointed brakesman at the Dolly Pit. Andrew Robertson, unwilling to lose his best pupil, went with them, and George continued his arithmetic lessons as before.

His wages were now from 17s. 6d.to £1 a week, and he managed by various means to add considerably to this sum. Sometimes he would sell some of his famous breed of rabbits ; often in the long hours when he was on night-shift he would mend shoes, and later even made them.

Among the clumsy big shoes brought to him to be mended was one smaller, neater pair, and into the repairing of these Stephenson put his very best work, thinking often as he laboured of the pleasure with which he would take them back to their owner. For the shoes belonged to Fanny Henderson, and it was she whom Stephenson wished to make his wife. She was a young farm-servant, pretty and sweet-tempered, and possesed of plenty of sound common sense.

By means of his cobbling Stephenson managed to lay aside his first savings—a guinea—telling his mate he was "now a rich man." He had soon added enough to the guinea to take the upper room of a cottage at Willington Quay, where he had been made brakesman. Here on March 28th, 1802, he brought

his bride. They were very happy together, and their happiness was made perfect by the birth, a year later, of a son, named Robert after his grandfather. The man who felt affection for all living creatures now poured forth the full love of his heart on his little son.

But this bright happiness was soon to be dimmed. Three years after his marriage, and soon after he had been appointed brakesman in the large colliery of Killingworth, his young wife died. Even his love for his child could scarcely soften the blow, and when an offer was made to him to take charge of an engine in Montrose, he accepted it with relief, thankful to leave for a time the scene of his great happiness. He left the child with a kind neighbour, and started off, pack on back, to make his way to Montrose on foot. During the time he was in Scotland he earned good wages, but his heart turned back to his own country, and at the end of a year, with his savings of £28, he set off once more and tramped back to Killingworth.

It was a sad home-coming. She who should have welcomed him was there no longer, and a terrible accident had befallen his kind old father. While he was inside an engine, another workman, unknowingly, let in the steam, blinding him for life. His other sons could earn barely enough to keep themselves, and the poor old man could only long in silence for George's return. Now George had come, and soon the debts were paid, and old Robert

Hard Times

Stephenson and his wife were settled in a comfortable cottage close to George's own. Here little Robert would come on his donkey to visit his grandparents, who 'spoiled' him to their hearts' content. Robert himself tells of these visits: "Many a time have I ridden straight into the house, mounted on my cuddy, and called upon grandfather to admire his points. I remember the old man feeling the animal all over—he was then quite blind—after which he would dilate upon the shape of his ears, fetlocks, and quarters, and usually end by pronouncing him to be 'a real blood.'"

On his return Stephenson was again made brakesman. But the times were hard, and in addition to his personal troubles he had to suffer for those of his country. In these years of 1807 and 1808 the war against Napolean was fast draining the country of its resources, both in men and in money, and the burden fell most heavily on those who were least able to bear it. There was a constant demand for recruits, and an able-bodied man was liable at any time to be impressed for service in the army or the navy. Recruits for the militia were drawn by lot.

Wages were low, and taxes many and high. The income-tax alone was a large item for such men as George Stephenson, since the tax on incomes of £50 a year and upward was 10 per cent. Bread and most other food-stuffs were scarce and dear. Every seventh person in England was a pauper, which meant that very high poor-rates were necessary.

Fifteen pounds of Stephenson's savings had gone to pay his father's debts, and from this time onward he maintained his parents entirely. This he was quite able to do, as there was little danger of his being unemployed. A much greater hardship was his being drawn for the militia. He must either go or pay some one to take his place.

He did find a substitute, but it took nearly all his remaining money to pay him. So much discouraged did he feel that when his sister Ann and her husband emigrated to America, it was only the lack of ready cash that prevented his accompanying them. Grateful indeed he must have been later to that timely poverty, but at the time it was a bitter trial. The future held out no hope to him of bettering his condition in his own country, yet the thought of leaving his home came as a blow upon the heart. Long afterward he said to a friend: "You know the road from my house at the West Moor to Killingworth? I remember when I went along that road I wept bitterly, for I knew not where my lot would be cast." The sturdy North Country temperament does not yield readily to emotion, and his tears are the measure of his despair.

However, he was not the man to waste time in repining when action was possible, and soon he gave his whole mind to the problem of earning sufficient money to carry out what was now his greatest desire: the obtaining of a good education for his son. In a

North Country temperament does not yield readily to emotion, and his tears are the measure of his despair.

However, he was not the man to waste time in repining when action was possible, and soon he gave his whole mind to the problem of earning sufficient money to carry out what was now his great desire: the obtaining of a good education for his son. In a speech made a generation later he spoke of this: "In the earlier period of my career, and when he was a little boy, I saw how deficient I was in education, and made up my mind that I would put him to a good school. I determined that he should have as liberal a training as I could afford to give him. I was, however, a poor man, and how do you think I managed? I betook myself to mending my neighbours' clocks and watches at night, after my daily labour was done. By this means I saved money, which I put by, and in course of time I was thus enabled to give my son a good education."

The ability to mend clocks was the fruit of an accident that occurred in the early days of his married life. One day he came home to be greeted by a melancholy spectacle: the room was all in disorder, ashes and soot covered the furniture, and pools of dirty water stood on the floor. During his absence the chimney had taken fire, and the over-zealous neighbours had poured water enough on the fire and down the chimney to extinguish a dozen such conflagrations. Worst of all, the eight-day

clock, in which they had taken great pride, was choked with ashes, and its works were injured by the steam. George could not afford to send it away to be repaired, and after the first feeling of dismay had passed he cheerfully set to work to mend it himself. He took it to pieces, cleaned all the parts, and put it together again with such care that it ticked once more as steadily as if it had never been disturbed. The report of this achievement soon spread, and all the clocks of the neighbourhood were brought to George to be cleaned.

Not only did he clean the pitmen's clocks and make their shoes; he even cut out their clothes, and his 'cut' was said to be unrivalled. With all these minor avocations in addition to his regular work, he can have had little time to himself; but all he had was turned to good account. He was still constantly studying the actual engines before him, and the accounts of other engines and mechanical contrivances which he found in books, and he was as constantly suggesting and effecting improvements in various parts of the colliery. Two of these improvements may be mentioned here.

He found that the ropes in use at his own colliery were rapidly worn by friction, and as, owing to the war, rope was very dear, he considered the possibility of preventing the rubbing, and succeeded in doing this by re-arranging the pulley-wheels and the gearing of the machine.

A new pit was sunk at Killingworth, and an engine put in to pump out the water, but,

pump as it might, the water flowed in as steadily as ever, and, "all the engine-men in the neighbourhood were clean beat." This continued for a whole year. Stephenson often went over to see the engine, and to his question, "How is she getting on?" received always the same reply, "Drowned out, drowned out." One day Kit Heppel, a friend of his who worked at the pit, noticed Stephenson's close scrutiny of the engine, and asked him, "Weel, George, what do you mak' o' her? Do you think you could doctor her?" "Man," said George, "I could alter her, and make her draw; in a week's time from this I could send you to the bottom."

Kit lost no time in telling Mr. Dodds, the head viewer, of these bold words, and he, feeling that matters could at all events be no worse, hastened to find George, and to tell him that since he thought he could put the engine to rights, he should have a fair trial. George knew there would be jealousy among the old colliery hands at the intervention of a young brakesman, and he stipulated that he should be allowed to choose his own assistants. Mr. Dodds granted this, and George and his men started work next morning. They took the engine to pieces, made sundry alterations and repairs and four days later put the engine together and started pumping once more. In less than two days no more water was to be seen, and George made good his word by sending the men down in safety. His immediate reward was a gift of £10, and the

appointment as engineman at the pit.

He still kept on working at arithmetic, helped now very greatly by his friend John Wigham, the son of a neighbouring farmer. Wigham was much better educated than anyone with whom Stephenson had as yet come in close contact; he knew a little chemistry and physics, he was fond of experimenting, and could not only read, but think and express his thoughts. Such a companion was an incalculable boon to Stephenson, and John Wigham was wise enough to appreciate his friend, and good-natured enough to give him all the help he could. He was a better teacher than Andrew Robertson, and under his guidance Stephenson soon mastered all the ordinary rules of arithmetic. Wigham also taught him the elements of mechanical drawing, in which the pupil soon excelled the master.

Stephenson was now comfortably off. His savings had reached the sum of £100, and in 1812 he had been made engine-wright at Killingworth at a salary of £100 a year. Though he never ceased to work to the top of his bent, he was now set free from drudgery, and could arrange his employment as best suited himself. He was encouraged by Sir Thomas Liddell, one of the lessees, to make many improvements in the machinery of the colliery. One of these was the making of a self acting incline, on which the full wagons as they went down automatically drew up the empty ones.

CHAPTER IV : *Robert's Education*

ROBERT went first to a small village school, and then at the age of eleven or twelve to Bruce's Academy in Newcastle.

The neighbours liked to watch the little boy, dressed in a rough grey suit cut out by his father, with his books and lunch in a satchel slung over his shoulder, setting out in the early morning on the donkey or 'cuddy' his father had bought for the purpose. Robert inherited his father's persevering, industrious nature, and was so often held up by the master as an example to the other boys that it says something for his character that the less diligent lads nevertheless regarded him as a jolly comrade. At first, indeed, they made fun of his countrified way and his broad Northumberland accent, but he soon learned their mode of speech, and they found him always ready for fun.

Once toward the end of his life, when Robert Stephenson asked an old labourer at Killingworth if he remembered him, the old man replied, "Aye, indeed! Haven't I paid your head many a time when you came with your father's bait, for you were always a sad hempy!" He himself tells of one of his tricks: "Straker was a great bully, a coarse, swearing fellow, and a perfect tyrant among the

women and children. He would go tearing into old Nanny the hucksters shop in the village, and demand in a savage voice: 'What's yer best ham the pund?' 'What floor the hunder?' 'What d'ye ax for prime bacon?' —usually ending with the miserable order, accompanied with a tremendous oath, 'Gie's a penny row [roll] an' a bawbee herrin'.' The poor woman was usually set 'all of a shake' by a visit from this fellow. He was also a great boaster, and used to crow over the robbers whom he had put to flight—mere men in buckram, as everybody knew. We boys believed him to be a great coward and determined to play him a trick. Two other boys joined me in waylaying Straker one night. We sprang out and called upon him, in as gruff voices as we could assume, to 'Stand and deliver!' He dropped down upon his knees in the dirt, declaring he was a poor man, asking for mercy, and imploring us as gentlemen to 'let him a-be!' We couldn't stand this any longer, and set up a shout of laughter. Recognizing our boys' voices, he sprang to his feet again and rattled out a volley of oaths, on which we cut through the hedge, and heard him shortly after swearing his way along the road to the alehouse."

Another trick of which Robert Stephenson was always proud to tell was the result of his reading of scientific books. He saved up his Saturday pennies until he had enough money to buy a good length of copper wire.

With this he prepared a kite, and then, having insulated it by a few feet of silk cord, he brought down the wire over the backs of some of Farmer Wigham's cows, causing them to make the best attempt they could at 'jumping over the moon.' This preliminary experiment having succeeded, he waited until his father's pony was brought out, ready for him to mount, and then gave it a similar electric shock. George Stephenson came out in time to witness the effect but though he made a display of cracking his whip at the 'mischievous scoundrel,' he was none the less secretly delighted at the 'scoundrel's success.'

Robert's liking for experiments was not surprising, for his father was always at some new 'ploy.' He still repaired clocks and watches, and still had sundry animals and birds about the house. One of his blackbirds lived in a cage just within the door, and when Stephenson came in it would greet him by cocking its head on one side and flying on to his outstretched finger. His garden door, had a peculiar fastening so that only he could open it, and in the garden itself was a wonderful scarecrow or 'fly-craw' that moved its arms with the wind. Protected by this queer figure were rows of enormous cabbages and leeks. Only one of his neighbours could boast that his cabbages were larger than George's. Inside the house was an oven built by his own hands, and indeed the house itself was built chiefly by him, for he enlarged it from

one room to four. He won the prize in a contest for the best shoe-last; he made an alarum for the watchman's clock; he showed the pitmen's wives how to make their cradles rock automatically by connecting them with the 'jack' at the fire; and he contrived a lamp that would burn under water and attract the fish so that they could be caught by hand.

Robert was not only learning himself, but helping his father with his studies. Having joined the Newcastle Literary and Philosophical Institute, he spent much time in its library, and when he went home on Saturday afternoons he would take with him a volume of the *Edinburgh Encyclopaedia*, or some scientific work, which would give his father and John Wigham material for many experiments and much discussion. Many of the books, however, were for reference only, and could not be taken away from the library, but Robert's memory was good, and where memory or notes failed a sketch could often serve as a description. His father taught him that "a good drawing or plan should always explain itself," and after some practice they could both 'read' plans and diagrams so easily that written descriptions were unnecssary.

Above the cottage door was a large sun-dial, made by the father and son. When Stephenson suggested a sun-dial, "I expostulated with him at first," Robert said afterward, "that I had not learned sufficient astronomy and mathematics to enable me to make the necessary calculations. But he would have no

denial. 'The thing is to be done,' said he, 'so just set about it at once.' Well, we got a Ferguson's *Astronomy*, and studied the subject together. Many a sore head had I while making the necessary calculations to adapt the dial to the latitude of Killingworth. But at last it was fairly drawn out on paper, and then my father got a stone, and we hewed and carved and polished it until we made a very respectable dial of it; and there it is, still quietly numbering the hours when the sun shines."

The date carved on it is "August 11th, MDCCCXVI."

It was much admired by the pitmen, who would direct inquirers for George Stephenson to "the house with the sun-dial." George and Robert themselves were proud of the achievement, and long afterward would take their scientific friends to see it.

Robert left school in 1819, and for the next three years acted as apprentice to Nicholas Wood, the head viewer of the Kilingworth mine. He thus gained by practical experience a thorough knowledge of the workings of a coal-mine. The evenings in the cottage were spent as before, in reading, planning, and discussing, the favourite subject being that of steam locomotion, for which Robert's enthusiasm was, if possible, greater than his father's.

In 1820 George Stephenson married his second wife, Elizabeth Huidmarsh, daughter of a farmer at Black Callerton. She was an

excellent wife to George, and a kind mother to Robert, whom she regarded as her son.

When Robert was nineteen, his father felt that, though the young man was in some respects well trained, he yet needed more in the way of technical instruction if he were to make the most of his profession. Moreover, he himself was always conscious of his own ignorance of scientific subjects, and felt that if Robert had a deeper knowledge of chemistry and physics, it would be an inestimable advantage not only to the boy but to himself.

He therefore made up his mind to send Robert to study at Edinburgh University. This was no small matter, for even the one session's study which he proposed cost him £80, a large sum even in his improved circumstances. George Stephenson, however, never grudged money for such an object, and besides, he realized that, from the financial aspect alone, it would bring in interest a hundredfold. Robert appreciated the difficulty his father had in collecting the funds for his college course, and before going to Edinburgh he learned shorthand, so that he might take down every word of the lectures, and make the most of his short time.

He attended three classes—chemistry (Dr. Hope), natural philosophy (Sir John Leslie), and natural history (Dr. Jameson). He took, as he had intended, complete notes of all the lectures, and at night he copied them out neatly, so that his father might have the benefit of them on his return.

He took with him letters of introduction to several engineers and literary men in Edinburgh, and enjoyed his time there, not only because of the opportunity for study, but for the pleasure he naturally took in the fine scenery, the sense of comradeship with others of his own age, and the first chance of entering in a modest way into the society of educated men. Naturally, also, he fell in love, with one bonnie Jeanie, a boyish affection which was soon forgotten, sooner by him than by poor Jeanie, whose family became ruined, leaving her in poverty and distress. She remembered the kind-hearted young engineer, and wrote to him for help, which he readily gave, continuing to send her a certain sum annually until her death.

Before his return Robert went with Professor Jameson and a party of students on a tour to the Highlands, as far north as Inverness. Not long before his death Robert Stephenson recalled the pleasures of this early tour: "I have travelled far, and enjoyed much, but, that delightful botanical and geological tour I shall never forget; and I am just about to start for a trip round the east coast of Scotland, returning south through the Caledonian Canal, to refresh myself with the recollection of that first and brightest tour in my life."

In the summer of 1823 Robert came home, and his father's delight at seeing him was equalled by his pride when Robert handed to him the prize he had won for mathematics.

CHAPTER V : *Pioneers of Locomotion*

IT is necessary now to leave the Stephensons for a little in order to recall the stage which had been reached at that time in the development of means of transport.

The object of the early railways was the transport of heavy goods from one place to another as easily and quickly as possible, and it was in the collieries of the North of England, with their constant pressing need for such transport, that railways had their origin.

The wagons of coal were originally drawn by horses, and for a long time the only improvement thought of was to make the surface of the road as smooth as possible. But even the best of roads, if it is to be kept in good condition, is in need of constant attention, and about 1630 a better idea occurred to a pit-owner near Newcastle, Beaumont by name. This was to lay wooden rails on which the wagons could run from the pit to the river. As described in 1791 by a French traveller, Saint-Fourd, the wooden rails had a rounded surface, and the iron wagonwheels were hollowed to fit them. By this means one horse could draw a much heavier load (50 or 60 bushels of coal). These roads were called 'wayleaves,' because a

considerable sum had to be paid annually to the owner of the ground for *leave* to make use of his land as a way.

Even 150 years later the railroads had not been much improved, and nine or ten miles was thought a long distance for the rails to extend.

In the course of time it was found that the surface of the rails became roughened by constant friction, and thin iron plates were nailed on to protect them. The next step was to make the rails themselves entirely of cast-iron. This was done at the Whitehaven Colliery in 1738.

But all this time it was only the railroad that had been improved. No one had as yet been able to effect an improvement in the means of moving the wagons. It would be untrue to say no one had thought of such improvement. There is a pathetic story told by Marion de Lorme of a man with ideas beyond his time, who instead of being honoured for his inventive genius, was despised and shut up in a madhouse. This was a Frenchman, Solomon de Caus, who lived in the beginning of the seventeenth century. This is De Lorme's account of a visit he and the Marquis of Worcester paid to the madhouse: "We were crossing the court, and I, more dead than alive with fright, kept close to my companion's side, when a frightful face appeared behind some immense bars, and a hoarse voice exclaimed: 'I am not mad! I am not mad! I have made a discovery that

would enrich the country that adopted it.' 'What has he discovered?' asked our guide. 'Oh!' answered the keeper, shrugging his shoulders, 'something trifling enough—you would never guess it; it is the use of the steam of boiling water.' I began to laugh. 'This man,' continued the keeper, 'is named Solomon de Caus; he came from Normandy four years ago, to present to the King a statement of the wonderful effects that might be produced from his invention. To listen to him, you would imagine that with steam you could navigate ships, move carriages—in fact, there is no end to the miracles which, he insists upon it, could be performed. The Cardinal sent the madman away without listening to him. Solomon de Caus, far from being discouraged, followed the Cardinal wherever he went with the most determined perseverence, and he, tired of finding him for ever in his path, and annoyed at his folly, shut him up in in the Bicetre. He has even written a book about it.'" The Marquis of Worcester was wise enough to admire the poor prisoner, and quoted from his book in his own *Century of Inventors*. Nothing came, however, of De Caus' ideas.

An essay published in 1698 tells of the use of sails by Sir Humphrey Mackworth, for propelling the coal-wagons in his Welsh mines; it speaks of these "new sailing-wagons, for the cheap carriage of his coal to the waterside, whereby one horse does the work of ten at all times; but when any wind is stirring (which

is seldom wanting near the sea) one man and a small sail do the work of twenty." Sir Humphrey, however, seems to have been a solitary enthusiast, for we hear no more of this means of propulsion until half a century later, when it was suggested by a Mr. Edgeworth, who thought that "upon a long extent of iron railway, in an open country carriages properly constructed might make profitable voyages from time to time with sails instead of horses, for though a constant or regular intercourse could not be thus carried on, yet goods of a certain sort, that are saleable at any time, might be staid till wind and weather were favourable." Mr. Edgeworth himself experimented with a sailing carriage, but it was not a success.

The idea of using steam for locomotion seems to have presented itself to many minds, without as a rule resulting in any but very tentative experiments. The first man in England to whom it occurred would seem to have been Sir Issac Newton, who in 1680 described a steam carriage on wheels, capable of conveying one person. The steam-generator was to be "a ball," with a pipe protruding at the back; "the whole is to be mounted on little wheels, so as to move easily on a horizontal plane, and if the hole, or jet-pipe, be opened, the vapour will rush out violently one way, and wheels and the ball at the same time will be carried the contrary way." The idea, however, remained on paper.

In 1765 Dr. Erasmus Darwin of Lichfield,

the ingenious physician, poet, and philosopher was much taken by the notion of a "fiery chariot." As he rode along the Staffordshire lanes in his doctor's 'sulky,' a great pile of books ready to his right hand, and a hamper of fruit and cream and sweetmeats on his left, he pondered much over this idea, and later gave the fruit of his meditations in a letter to his friend Boulton, who had made a model of a fire-engine. Dr. Darwin's proposed engine was impracticable, and was never more than planned. It is important chiefly as having brought the subject of steam locomotion before the mind of Darwin's young friend and neighbour, Mr. Edgeworth. Later in life, Edgeworth gave up the idea of sails, and felt that steam must be the power of the future. In 1813, too old to do more than encourage the younger generation by his words, he wrote to Watt: "I have always thought that steam would become the universal lord, and that we should in time scorn post-horses. An iron railroad would be a cheaper thing than a road on the common construction." The far-seeing old man died in 1817, eight years too soon to see the fulfilment of his prophecy.

In 1759 the plan of applying steam to carriages was suggested by Dr Robinson to his friend James Watt. Watt took out patents for steam-engines, in 1769 and 1784; in his second engine, "the boiler was to be of wooden staves hooped together with iron; the iron furance inside the boiler, and almost entirely surrounded with water; the whole being placed on

a carriage, the wheels of which were to be worked by a piston." The carriage was to be large enough to convey two people. Watt's scheme never materialised.

About 1770 an actual engine was built by a French-man named Cugnot, but having knocked down a wall it was thought to be too powerful a monster, and was put into a museum.

In Scotland and America too steam-engines were made, notably one in 1786 built in Edinburgh by Symington, the inventor of the steam-boat, but none of the inventors went any further, owing, in Scotland at all events, to the almost incredibly bad state of the roads.

A pupil of James Watt, William Murdoch, who discovered the means of making gas from coal, constructed a tiny steam-carriage, about one foot high. It ran on three slender iron wheels, two large ones at the back, and a smaller one in front. It worked excellently and could go at a great rate; indeed on the occasion of its first being tried on a road, it went too quickly. Murdoch dared not test it during the day, but one night he filled and trimmed the lamp, and took the little engine some distance from his cottage; then, his heart beating high with expectation, he got up steam. Sure enough the engine started off, its inventor striding along behind it. It puffed along until he was left some distance behind, too far to see it in the darkness, when from the direction in which it had gone he

heard shrieks of dismay. He hastened after it, and came upon the village clergyman, who was making for the nearest house in a state of panic. He had taken the engine for an evil spirit, and entertained no desire to combat the powers of darkness in so material a form. Though Murdoch had gone so far, he never tried to make a larger or more useful engine.

But now the scheme of employing steam for carrying coal on the railways was actually mooted, by Mr Thomas at Newcastle, and in Edinburgh by Dr Anderson. At the same time Murdoch in his turn had fired the ambition of a pupil of his own, a Cornish-man, Richard Trevithick. In 1800, when Stephenson was nineteen, Trevithick succeeded in constructing a steam carriage on four wheels, capable of running on an ordinary high-road. The most original point in this engine was that the piston was moved both ways, on both its upper and its under side, by the action of the steam. Trevithick and his cousin, Andrew Vivian, who had supplied the money for the enterprise, wished to exhibit the carriage in London, and decided to travel as far as Plymouth in the carriage itself. Presently they came to a toll-gate, but they were going at such a rate that they almost dashed into it before they could check their speed. They managed to stop just as the terrified gate-keeper flew out to open to them. "What is to pay," called out Vivian. The man clung to the gate-post and stammered out; "N—n—nothing to pay! My dear Mr

Devil, drive on as fast as you can! Nothing to pay!"

The exhibition was a great success, but owing to the bad state of the roads at that time no practical use could be made of the carriage.

In 1804 Trevithick built another engine for the express purpose of using it in a colliery at Merthyr Tydvil. It was partially successful, but was too heavy for the railroad, and too jolting in its motion. It was very little used for drawing wagons, and was soon taken as a pumping engine.

Trevithick and others thought that since the iron rails and the engine were both smooth, any heavy weight attached to the engine would cause the wheels to slip. In order to make them 'bite,' a Mr Blenkinsop of Leeds invented and patented a toothed or cogged rail, and correspondingly cogged wheel, which should work into each other. Only one side of the line was to be cogged. This was successful, and engines of this kind were in use for many years at the Leeds collieries. The railway was three and a half miles long, and the engines could pull thirty wagons along it in little more than an hour.

As a Newcastle pit-owner had been the first to lay down good wooden rails, so it was again a Newcastle pit-owner who persevered in employing a locomotive-engine to draw his wagons. The owner this time was Mr Blackett, of the Wylam Colliery, known also as the proprietor of the *Globe*. It was

by the side of his wagon-way that Robert Stephenson's cottage stood, and from his wagons that George had guarded his little brothers.

About 1811 Mr Blackett bought his first engine from Trevithick, but never used it. In 1808 he had laid down a cast-iron line, on which one horse could draw two wagons. In the following year he adopted Blenkinsop's cogged rail and wheels, and in 1812 he had another engine built, on Trevithick's patent model, by Waters of Gateshead. It proved absurdly clumsy and too heavy for the road (it had eight wheels and weighed about six tons), and when after great pains it was at last settled on the rails and started, it burst before the eyes of the exhausted and irritated workmen. "She flew all to pieces," one of them related, "and it was the biggest wonder i' the world that we were not all blown up." The workmen, cursing the cumbersome machine, took 'her' off the rails, fondly hoping that their master was now cured of his fancies. But Mr. Blackett was undaunted. Trusting that 'the third time would do it,' he had yet another engine built, this time in his own workshops at Wylam. It had four wheels, the driving-wheel on one side being cogged. It was rough and cumbrous, and eight or nine wagons were the limit of its load, but the great fact remained that it did go. At the same time, it was still too heavy for the rails, so that they frequently broke; it achieved a speed of little more than

one mile an hour; any part of it was liable at any moment to go out of order, and not seldom it went off the rails altogether. Little wonder the workmen accounted it "a perfect plague."

Mr. Blackett's next experiment was made with a frame mounted on four cogless wheels, and its object was to test the power of the smooth wheels to keep on the rails. Six men stood on the frame, working the wheels by means of windlasses; and it was found that if a sufficiently heavy weight were placed on the frame, this alone would prevent slipping, even with a heavy load attached behind. Toothed rails and wheels were thus once and for all proved to be unnecessary.

It must be remembered that the railroad ran along High Street Road, and an amusing story is told of a stranger walking quietly along on a dark evening, and being horror-struck by the sudden sight of 'Black Billy,' a great monster breathing out flame and smoke as it came panting and groaning along in the dark. He fled wild-eyed from the "terrible deevil!"

Human beings could have the monster explained to them, but animals were another matter, and a fruitful source of trouble was the state of terror into which passing horses were thrown by the sudden blowing-off of steam from the engine. Finally Mr. Blackett, was obliged to order the locomotives to be stopped as soon as a horse came in sight.

If travellers had been annoyed before, it

was now the workman's turn to object, and hence a new scheme was put into practice. The waste steam was allowed to pass into a special reservoir, placed behind the chimney and thence into the air, so gradually as to preclude noise. This arrangement met the immediate difficulty, but its inherent defect will be seen later.

CHAPTER VI: *Stephenson's First Engine*

AT the time of Mr Blackett's experiments, George Stephenson, it will be remembered, was engine-wright at Killingworth; he thus had every opportunity of watching the progress of the several locomotives tried at the Wylam Colliery. He went to see them as often as possible, and having thoroughly examined 'Black Billy' he told his friends that he felt sure he himself could build a better engine. He was of the same opinion in regard to one of Blenkinsop's engines which he saw working in 1813. This was a less cumbrous machine than any Stephenson had yet seen, but it was still highly unsatisfactory in practice.

Stephenson determined to make an engine that should surpass all existing models, and to this end he now bent all his energies.

He could not achieve anything unaided; in order to put his ideas in practice he must have money, skilled mechanics, and good tools. The money was readily advanced by Lord Ravensworth, the principal lessee of the Killingworth Colliery, who had gauged Stephenson's power aright; the mechanics and tools were more difficult to procure, and for the most part Stephenson had to make the best of what the colliery could supply. His chief mechanic was John Thirlwall, the colliery blacksmith.

The building of the engine took about ten months, and it was tested for the first time on 25th July, 1814, when it succeeded in drawing thirty tons' weight uphill at four miles an hour.

It was mounted on a wooden frame with four wheels, all the wheels being smooth. Its most noteworthy feature was that the motive power was communicated to the wheels by means of spur gear; and its chief disadvantage was the jolting and jerking caused partly by the entire absence of springs, and partly by the spur-gear arrangement, by which the two cylinders propelled each other alternately.

The official name of the engine was 'My Lord,' but the workmen knew it as 'Blucher,' an appellation presumably given out of compliment to the Prussian general.

The engine continued in regular use, and at the end of a year it was found that in both speed and cost there was no appreciable difference between the locomotive and horse-power. Taking into consideration the cost and labour of building the engine, the locomotive was not likely to prove popular unless some decided saving could be effected thereby, so that had Stephenson stopped at this point the progress of locomotives might have come to a standstill also.

However, Stephenson was not in the habit of stopping short of what he considered complete success. He continued to observe, to consider, and to experiment, and the result was the application of the steam-blast, which more than doubled the power of his engine.

Stephenson's First Engine

The problem of what was to be done with the steam after it had done its work in the cylinders, had never been solved satisfactorily by Trevithick. In his engines, and in 'My Lord' as first constructed, the waste steam was allowed simply to escape into the atmosphere, with or without some arrangement to prevent the startling sight and sound produced by the sudden hissing jet as it escaped. The very fact of this violent hiss showed the intense velocity with which the steam shot forth from the exit pipe, and what Stephenson now proposed to do was to make use of this hitherto wasted power. He therefore caused the steam to escape into the chimney, and this greatly increased the draught of the chimney and hence the intensity of the fire in the furnace.

Stephenson made other improvements in his engine, and early in 1815, with the financial help of his friend, Mr. Dodds of Killingworth, took out a patent for a new engine in which all these improvements were incorporated. In this engine the two vertical cylinders were directly connected with the wheels by a pair of correcting rods, joined to a cross-head by means of ball-and-socket joints. This secured the requisite flexibility, so that if at any point on the line one of the rails should be lower than the other, the cross-head and the axle of the engine would still remain parallel, and jars would be largely prevented.

CHAPTER VII: *The 'Geordy' Safety-lamp*

THE greatest danger with which the miners had to contend was that of explosion from fire-damp. Fire-damp is the name given by miners to coal-gas (carburetted hydrogen) which exists in a compressed state in coal-seams, and escapes, sometimes so violently as to make a sound. On mixing with atmospheric air it becomes explosive.

In 1806, while Stephenson was brakesman, an explosion took place, and ten persons were killed. Thirty years later, in giving evidence before the Select Committee of the House of Commons on Accidents in Mines, Stephenson said, regarding this explosion: "The pit had just ceased drawing coals, and nearly all the men had got out. It was some time in the afternoon, a little after midday. There were five men that went down the pit; four of them for the purpose of preparing a place for the furnace. The fifth was a person who went down to set them to work. I sent this man down myself, and he had just got to the bottom of the shaft about two or three minutes, when the explosion took place. I had left the mouth of the pit, and had gone about fifty or sixty yards away, when I heard a tremendous noise, looked round, and saw the discharge come out of the pit like the discharge of a

cannon. It continued to blow, I think, for a quarter of an hour, discharging everything that had come into the current. There was wood came up, stones came up, and trusses of hay that went up into the air like balloons. Those trusses had been sent down earlier in the day, and I think they had in some measure injured the ventilation of the mine. The ground all round the top of the pit was in a trembling state. I went as near as I durst go; everything appeared cracking and rending about me. Part of the brattice, which was very strong, was blown away at the bottom of the pits. Very large pumps were lifted from their places, so that the engine could not work. The pit was divided into four by partitions; it was a large pit, fourteen feet in diameter, and partitions were put at right angles, which made four compartments. The explosion took place in one of those four quarters, but it broke through into all the others at the bottom, and the brattice, or partitions, were set on fire at the first explosion. After it had continued to blow for a quarter of an hour the discharge ceased, and the atmosphere all round poured into the pit to fill up the vacant place that must have been formerly occupied by the flame. In one of the other pits, that was connected by some door in a drift with that in which the explosion took place, were several men, some of whom succeeded in getting up safe. The ropes in the first pit were shattered to pieces by the force of the blasts, but the ropes in the

other pits were still left comparatively uninjured. Nobody durst go near the shafts for some time, for fear of another explosion taking place. At last we considered it necessary to run the rope backwards and forwards, and give the miners, if there were any at the bottom of the shaft, an opportunity of catching the rope as it came to the bottom. Whenever the rope went to the bottom it was allowed to remain a short time, till we considered the men had time to cling to it. Several were safely got up in this way; and another man got hold of the rope, and was being drawn up, when a further explosion took place at the time he was in the shaft, but it was merely like the discharge of a gun, and it did not continue like the former blast. This man, it appeared, had been helped up so far by the increased current which came about him that, the rope running up at a great velocity, he was projected up the shaft, yet he was landed without injury; it was a singular case. Four out of the five men who had been sent down just before the explosion took place, were not seen again for three or four-and-twenty weeks, when they were found buried among the corves and little carriages at the bottom of the shafts. The overlooker, who had gone to set these men to work, knew the situation they were likely to be placed in; and, hearing the noise of the explosion before it reached the shaft, he threw himself behind some pillars near the pits, so that the current went past him, but the

flame came about him, and nearly all his clothes were burnt off his back, though he laid himself down flat upon his face for safety. After the blast ceased, this person got up and found his way round to the other pit, where he got up by the rope in the manner stated. The pit continued to blast every two or three hours for about two days. It appears that the coal had taken fire, and as soon as the carburetted hydrogen gas collected in sufficient quantity to reach the part where it was burning, it ignited again; but none of the explosions were equal to the first, on account of many parts of the mine having become filled with azotic gas, or the after-damp of the mine. All the ditches in the country-side were stopped to get water to pour into the pit. We had extinguishing or fire-engines brought from Newcastle, and the water was poured in till it came above the fire, and then it was extinguished. The loss to the owner of the colliery by this accident must have been about £20,000."

This explosion, and other still more serious ones which occurred during the following years in neighbouring mines, led Stephenson to reflect on means of prevention, and in 1814 the need of some protection against fire-damp was brought home to him still more strongly. One day a workman brought him the terrible news of a fire in the deepest main of the colliery. He rushed to the pit-head, spoke calming words to the agonized women who had gathered there, and then at

once had himself lowered to the bottom of the pit. There he found the men waiting in terror for the danger that might come upon them at any moment. Stephenson called out: "Are there six men among you who have the courage to follow me?" and not six but all the men at once came forward. Together they hastily gathered bricks, and built a wall which kept out the air, so that the fire was put out. Nevertheless, some of the men had already been suffocated. Stephenson's friend, Kit Heppel, who was helping him to recover the bodies, asked him if he could not do something to prevent future explosions, adding: "The sooner you begin the better, for the price of coal-mining is *pitmen's lives.*"

A miner is obliged to have a light to guide him, but the coal-gas is so inflammable that a naked light might cause an explosion at any moment. In the Killingworth mines the parts most full of the gas were walled up and disused, the pit was ventilated by the best methods known, and various means were tried of getting rid of the bad air; but still, so long as a naked flame was used, the danger was never absent. In the parts of the pit in which there was apt to be much of the inflammable gas, candles could not be used, and the men had to work by the merest glimmer of light produced by sparks from a flint. The flint was struck by a notched wheel, turned by a boy.

What was needed was a safety-lamp. In 1815 Sir Humphrey Davy visited the Newcastle

collieries at the request of the owners, a visit which resulted in the invention of what is now commonly known as the Davy Lamp, first exhibited on the 9th November, 1815. Before that date Stephenson, who had been working hard at the same problem, though quite ignorant of Sir Humphrey Davy's experiments, had already made and tested two safety lamps entirely of his own invention, and on the 30th of the same month a third was tried, the one afterward famous as the 'Geordy' lamp. Stephenson, by means of observation and experiment, Davy by means of correct theory, had both arrived at practically the same result. Although Stephenson did not fully understand the general laws on which the principle of his lamp was based, yet in some cases his lamp was found in practice the superior of the two, the Davy lamp becoming red-hot in a highly explosive atmosphere, whereas the 'Geordy' lamp, under similar conditions, at once extinguished itself.

Robert Stephenson thus describes the arrival of his father's first lamp in October 1815: "I remember that evening as distinctly as if it had been but yesterday. Moodie came to our cottage about dusk and asked if father had got back yet with his lamp. 'No.' 'Then I'll wait till he comes,' said Moodie, 'he can't be long now.' In about half an hour, in came my father, his face all radiant. He had the lamp with him! It was at once uncovered and shown to Moodie. Then it was filled with oil, trimmed and lighted. All was

ready, only the head viewer hadn't arrived, 'Run over to Benton for Nicholas, Robert,' said my father to me, 'and ask him to come directly; say we're going down the pit to try the lamp.' By this time it was quite dark; off I ran to bring Nicholas Wood. His house was at Benton, about a mile off. There was a short cut through Benton Churchyard, but just as I was about to pass the wicket, I saw what I thought was a white figure moving about among the grave-stones. I took it for a ghost. My heart fluttered, but to Nichol's house I must get, so I made the circuit of the churchyard, and when I got round to the other side I looked, and lo!—the figure was still there. But what do you think it was? Only the grave-digger plying his work at that late hour by the light of his lantern set upon one of the grave-stones!

"I found Wood at home, and in a few minutes he was mounted and off to my father's. When I got home, I was told they had just left—it was then about eleven—and gone down the shaft to try the lamp in one of the most dangerous parts of the mine."

It was indeed an exceedingly dangerous mission on which they had gone. Moodie boarded off a part of the gallery where gas was escaping, and in about an hour he told Stephenson that if a naked light was taken to the place a great explosion would certainly occur, in which case not only would they themselves lose their lives, but the whole pit

would be endangered. Stephenson nevertheless insisted on carrying out the test, and while the others retired to a safe place, he went forward with the lighted-lamp in his hand. However great was his confidence in his inventien, it was a noble and daring act so to risk his own life in order that a chance might be taken of saving in the future the lives of many other men.

Stephenson found that when the lamp was placed in the foul air it first flamed up, then flickered and died out; no explosion took place. The lamp was imperfect, and went out too readily in purer air, but he felt that the essential principle had been discovered, and that in time he could bring the lamp much nearer to perfection. This he certainly succeeded in doing. By making repeated experiments, more than once at the risk of his own life, he demonstrated the fact that flame will not pass through tubes of a certain diameter, and he concluded that if he surrounded his oil vessel with tubes of a suitable size, or else made holes in two metal plates placed at a distance from each other equal to the length of the tubes, the flame would have sufficient air to make it burn, and would not cause an explosion; air being admitted through small holes in the cover of the chimney.

A heated controversy arose over the claim to priority asserted by both Davy and Stephenson, and since Davy was a famous man of science and Stephenson a humble

unknown workman, the scientists and general public naturally enough thought the latter's claim absurd. Finally it was decided to present Sir Humphrey Davy with the sum of £2000 as the inventor of the safety-lamp, and Stephenson with 100 guineas for his meritorious efforts.

Stephenson's friends were exceedingly indignant, and persuaded him, though with great difficulty, to publish an account, with diagrams of his lamps. Stephenson's sturdy common sense and love of honesty told him that it was right to vindicate his claims, the more so as some of Sir Humphrey Davy's partisans had gone so far as to insinuate that Stephenson had taken the idea of the lamp from Davy, but writing a letter to the papers seemed to him well-nigh an impossible task. Robert was given a sheet of paper and ordered to "put down there just what I tell you." After several evenings of hard work the letter was finally written and copied out neatly, in Robert's best hand. Then it was taken to Mr Brandling of Gosforth, who had all along done his best to get Stephenson's claim's recognized. Mr Brandling had not read very far when he stopped and said, "George, this will not do." "It's all true, sir," said Stephenson. "That may be, but it is badly written." Poor Robert looked down, very miserable and ashamed, but he was presently consoled when he found it was the style, not the penmanship, that was disapproved. Mr Brandling rewrote the letter

in a more polished style, and had it published in the local papers. The full account with diagrams was published in pamphlet form in 1817. In that year a meeting was held at Newcastle, with Mr Brandling in the chair, at which the following resolution was passed: "That it is the opinion of this meeting that Mr George Stephenson, having discovered the fact that explosion of hydrogen gas will not pass through tubes and apertures of small dimensions, and having been the first to apply that principle in the construction of a safety-lamp, is entitled to a public reward." A subscription list was opened, and the sum of £1000 was collected and presented to Stephenson, along with a silver tankard. A gift which he valued much more, more than any other gift he ever received, was the silver watch bought with the coppers of the colliers, and presented to him as a token of their regard.

CHAPTER VIII: *The Stockton and Darlington Railway*

THE coal used in London at the beginning of the nineteenth century was still as it had always been since the end of the thirteenth century, when the dearness of wood brought it into general use, 'sea,' that is, sea-borne, coal, carried by water from the northern mines. This coal had by some means to be conveyed from the Thames, where it was landed, and it was in connexion with its transport that the first public railway Act in the world was passed. This was the Act passed in 1801, authorizing the construction of the Surrey Iron Railway which was to run from Wandsworth to Croydon, for the purpose of conveying coal and stone. The line finally extended for twenty-six miles, and was worked until 1837, but it was never at all successful. The lack of profit from this line naturally acted as a deterrent from any similar subsequent project. In fact no suggestion for another line was put forward for nearly twenty years.

In 1819 the owners of a colliery at Hetton in County Durham, having noted the continued successful working of Stephenson's engine at Killingworth, asked him to construct a similar railway for their colliery. He undertook the work with the assistance of his brother

Robert, and the new railway was opened in 1822. It was a comparatively large one, eight miles long, and five of Stephenson's engines were in use upon it at one time.

For a long time owners of collieries in the Tees district had been trying to find some easy way of conveying coal from Bishop Auckland to the sea. The supply of coal round about Bishop Auckland was known to be well-nigh inexhaustible, and once at the coast it could easily be shipped to the London market, but since the Tees is not navigable, the problem of getting it transported was a difficult one.

A canal was suggested, to be cut through Darlington to Stockton, but for twenty years neither Stockton nor Darlington did anything more profitable than talk the matter over. In 1810 the idea of a railway was very tentatively mooted at Stockton, and again a year later more definitely at Darlington. Six years later, at Newcastle this time, a meeting was held to discuss the question of connecting the Tyne and the Solway by means of either a railroad or a canal. The canal gained the day, but no more was done.

In 1818 Stockton decided to cut a canal from Auckland to the Tees "if funds were forthcoming"—a saving clause, for funds were not forthcoming. This proved a fortunate circumstance, for now at last Darlington, having had the district surveyed by two competent engineers, gave its vote in favour of a railway. A railway could not be constructed

without money, however, and Stockton refused to give any assistance. But fortunately the leader of the project was a man of energetic character and great decision and strength of will, who 'could look a hundred years ahead,' and who regarded opposition merely as something to be overcome. This was Edward Pease, a member of the Society of Friends. Under his vigorous leadership, other friends formed themselves into an influential company, and the railway owed its inception so largely to these men that it was commonly known as 'the Quakers' Line.'

The Bill empowering the construction of the railway was thrown out in 1818, owing to the opposition of the Duke of Cleveland on the ground that the line would disturb one of his fox-covers. A fresh plan was made, avoiding the fox-cover, but the Bill was suspended for yet another year, owing to the death of the King, and the consequent dissolution of Parliament.

The Act as passed allowed the use of the railroad to any person who paid the tolls, and the charges were fixed at fourpence per ton of coal per mile, for coal intended for land-sale, but only a halfpenny for coal intended to be shipped at Stockton. This latter very low rate was meant to prevent competition with the coal shipped at Sunderland; as a matter of fact it was the source of huge profits to the Company. The preamble of the Act assured the public that "the making and maintaining of a railway or tramroad, for

the passage of wagons and other carriages, will be of great public utility, by facilitating the conveyance of coal, iron, lime, corn, and other commodities." Passenger traffic was unthought of. The railroad was to be open for public use "between the hours of seven in the morning and six in the evening" during the winter months; "between six in the morning and eight in the evening" in March, April, September, and October, and from five to ten in the summer months.

As on the Wandsworth railway, the trucks were to be drawn by horses. Despite the success of Stephenson's engine at Killingworth, and of the Hetton Railway, no other means of traction was considered for some time. The public was being advised, nevertheless, to adopt an extensive system of railways, and steam railways to boot, by an enthusiastic and pertinacious projector, Mr Thomas Gray of Nottingham. As a boy in Leeds, Mr Gray had seen Blenkinsop's engine at work, and the sight had produced in his mind an abiding conviction of the practicability of a steam railway. He lived for some time in Belgium, where he steadfastly advocated the construction of a railway in preference to a canal, for the purpose of connecting the Belgian mines with Holland. In 1820 he published a pamphlet, the fruit of several years' study, entitled *Observations on a General Iron Railway* (with plates and maps illustrative of the plan), showing its great superiority, by the general introduction of mechanic power

over all the present methods of conveyance by turn-pike roads and canals, and claiming the particular attention of merchants, manufacturers, farmers, and indeed every class of society. It did receive some attention, for in 1822 a fourth edition was published. This edition contained maps in which several suggested lines were shown, between the principal towns of England and Ireland.

Besides writing on the subject, Mr Gray ceaselessly advocated his schemes in conversation, holding men willy-nilly, like Socrates or the Ancient Mariner, until they had heard him out, and being called 'cracked' for his pains. "Begin where you would," says his friend William Howitt, "on whatever subject—the weather, the news, the political movement or event of the day—it would not be many minutes before you would be enveloped with steam, and listening to a harangue on the practicability and immense advantages, to the nation and to every man in it, of 'a general iron railway.'" If Thomas Gray did no other service to the growth of railways, he certainly helped to keep the subject 'in the air.'

The Darlington project was still producing no tangible result, and few people outside the company itself took any great interest in it, but to one humble workman it seemed the earnest of mighty events. Through it, he thought, might come the fulfilment of his life's ambition, and the realization of his dreams. For once, George Stephenson's daily work was powerless to hold his attention, and

at last he sought out Nicholas Wood. Some hours later, in the evening, Mr Pease was told that two men from Killingworth wished to see him. One of them introduced himself as Nicholas Wood, the viewer at Killingworth, and the other explained himself as "only the engine-wright at Killingworth, that's what I am!"—at the same time handing to Mr Pease a letter of recommendation.

Mr Pease liked the straightforward look and speech of the man who was "only the engine-wright," and with quick decision at once made up his mind that Stephenson was precisely the man to help him to carry out his plans. They discussed the projected line in all its aspects. Stephenson strongly advised a railroad instead of a tramroad, and then losing all his shy awkwardness as he warmed to his subject, he burst forth into a bold dissertation on the superiority of the locomotive over horse-power. "Come over to Killingworth and see my 'Puffing Billy,'" he urged finally, "seeing is believing, sir." Mr Pease promised to do so, and added, "I may observe to thee, George, that if thou succeed in making this a good railway, thou may consider thy fortune as good as made."

Mr Pease promised to use his influence with the other directors to secure the appointment of engineer for Stephenson, and the two men departed, to return to Killingworth 'by nip,' that is by tipping the stage-coachman to give them a lift.

Mr Pease felt his heart warmed and his

own courage strengthened by Stephenson's whole-hearted enthusiasm, and lost no time in persuading the other directors of the Stockton and Darlington Company to allow Stephenson a free hand in the construction of the line.

The messenger who took the letter offering Stephenson the post of engineer, rode all over the village of Killingworth in a vain attempt to find "George Stephenson, Esquire, Engineer." At last a collier's wife made the suggestion that it might be "Geordy the engine-wright" for whom he was looking.

The first rail of the Stockton and Darlington Railway was laid near Stockton in May 1822. Even at that stage it was intended to use horse-power, with stationary engines and ropes for the steeper gradients—no locomotives. But a month or two later Mr Pease did go over to see "Puffing Billy." He found his way to the "house with the dial," where Mrs Stephenson told him that her husband was at the colliery. A messenger was despatched, and very soon Stephenson appeared in his working clothes. It did not take long to bring "Puffing Billy" to the crossing near the cottage, and "Billy," with a train of loaded wagons behind him, puffed to such effect on this occasion that Mr Pease was converted on the spot to lasting faith in the powers of a locomotive engine. So much so that in the amended Stockton and Darlington Act, passed in 1823, he had a clause inserted which gave the company power to employ locomotive engines, and to carry passengers

as well as goods—the first clause of the kind in any Act.

Stephenson was appointed the company's engineer, at a salary of £300 a year.

CHAPTER IX: *The Opening of the Line*

STEPHENSON at once proceeded to survey the proposed route. There was no staff of skilled and experienced surveyors to be had. Every inch of the ground had to be surveyed by Stephenson himself, with the help of assistants whom he was training. His chief assistant was John Dixon.

He started very early in the morning, having admonished his assistants as they parted at night: "You must not set off from Darlington by daybreak, for then we shall lose an hour, but you must be here, ready to begin work as soon as it is daylight." Dressed in a blue tailed coat, top-boots and breeches, Stephenson set forth at this early hour, and worked hard until dusk. He did not trouble about regular meals, but relied on getting bread and cheese and a glass of milk at some cottage along the line; if he passed a farm its owner would press him to come in and join the family at dinner. His genial manner and interesting talk made him a welcome guest anywhere, and after the meal the children and the dogs would come crowding about him, sure of a kindly word.

He was equally welcome at Mr Pease's home, where his power of original thought was truly appreciated. On one of his visits

there he saw Mr Pease's daughters embroidering, and to their surprise informed them that he "could teach them to do that." "You'll wonder how I learnt it?" he said. "Well, I will tell you. When I was a brakesman at Killingworth, I learnt the art of embroidery while working the pitmen's buttonholes by the light of the engine-fire."

An important outcome of these visits to Mr Pease was the building at Newcastle of a manufactory for locomotive engines. There, Stephenson thought, could be trained the skilled mechanics of whom he was in such need. Towards the establishing of the manufactory Mr Pease and his friend Mr Richardson gave each £500, and Stephenson himself contributed the £1000 received for his safety-lamp, and still intact.

Stephenson was to a great extent working in the dark; he had only his own practical common sense and very limited experience to guide him. One of the points he and Mr Pease had to decide was the gauge of the railway, that is to say, the width of the line. They thought it best to retain the gauge of the first tramroads, which had followed that of wheels on ordinary carts, four feet eight and a half inches. Another point was the kind of rails to be used; should these be cast iron or wrought iron? Stephenson's answer to this question showed his honesty and single-mindedness. He himself in conjunction with Mr Losh had taken out a patent for cast-iron rails, but he frankly advised

the Directors against the use of these, since in practice wrought-iron rails had been found far superior. Mr Losh did not see matters in the same light, and he and Stephenson had a violent quarrel on the subject.

Stephenson's robust frame was a valuable asset in these days of hard mental and physical work; it pulled him through in spite of the constant strain; but his son's less sturdy constitution could not comply with the demands made upon it, and he was fain to accept an offer to go to South America to superintend some mining operations. Before he sailed the father and son were dining one day with John Dixon at a little inn in Stockton, and they drank success to the railway in a bottle of wine, an unusual indulgence for George Stephenson. "Now, lads," he said to the young men, "I venture to tell you that I think you will live to see the day when railways will supersede almost all other methods of conveyance in the country —when mail-coaches will go by railway, and railroads will become the great highways for the king and all his subjects. The time is coming when it will be cheaper for a working man to travel on a railway than to walk on foot. I know there are great and almost insurmountable difficulties to be encountered; but what I have said will come to pass as sure as you now hear me. I only wish I may live to see the day, though that I can scarcely hope for, as I know how slow all human progress is, and with what difficulty

I have been able to get the locomotive introduced thus far, notwithstanding my more than ten years' successful experiment at Killingworth."

At last the great day came on which the line was to be opened. The 27th September, 1825, was observed in Darlington as a great holiday. At six in the morning the proprietors were already at one of the inclines, where there was a fixed engine, and before very long a huge crowd had assembled all along the line, notice being given beforehand as to the times when the wagons would pass certain points. The procession started from the foot of an incline about nine miles from Darlington. It was headed, not by an engine, but by a man on horseback! He carried a flag bearing the company's motto, *Periculum privatum utilitas publica*, and perhaps he thought his own *periculum privatum* quite considerable. After him came a locomotive drawing six wagons loaded with coal and flour, a covered coach in which the directors rode, twenty-one wagons crammed with passengers, and finally six more wagons of coal.

George Stephenson himself was driving, and proud indeed he was. Presently as he came to a downward slope he determined to "give his engine her head," and calling to the horseman to get off the line, he put on full speed, and away went the engine at the unheard-of rate of twelve, and for a short distance fifteen, miles an hour.

Left far behind were the runners, who had

thought they could easily keep up with the five miles an hour that had been the highest speed expected, far behind were the superior gentlemen on horseback and the haughty individual with the flag; fortunate indeed were the 450 passengers who rode triumphantly into Darlington in the wagons. At Darlington more wagons were taken on, containing 150 passengers and a band. The procession finally reached Stockton "in three hours and seven minutes, including stoppages, the distance being nearly twelve miles." The rate during the latter part of the journey was only about five miles an hour, but by that time there were about 600 persons in the train or hanging on to the wagons.

The line was a complete success from the first not only as regards goods traffic, but the little-anticipated passenger traffic also. The company had placed its reliance on the transport of coals intended for sale inland; and had thought to derive little if any profit from transporting coals intended for the London market. The reason for this was the clause already mentioned as having been inserted in the Act, limiting the rate for coal taken to Stockton for shipment to one halfpenny per mile. This clause was put in at the instigation of Mr Lambton, who himself shipped coal to London from Sunderland, and wished to secure himself against competition. He supposed that the halfpenny rate would effect that end, as the conveyance of coal at so low a price would presumably

ruin the company; consequently they would, he thought, refuse to undertake such conveyance. The directors themselves were of the same opinion. No less to their surprise than to their gratification, the supposedly ruinous traffic proved the main source of the railway's success.

Only very little passenger traffic had been expected, as, previously to the construction of the railway, few people had passed to and fro between Stockton and Darlington; in fact a coach which had been started had had to be given up for lack of passengers.

But the opening of the line caused a great increase of trade between the two towns, so that many more persons found themselves obliged to travel for commercial purposes; and many others made use of the railway from curiosity and the love of novelty.

In 1824 the *Tyne Mercury* asked contemptuously, "What person would ever think of paying anything to be conveyed from Hexham to Newcastle in something like a coal-wagon, upon a dreary wagon-way, and to be dragged for the greater part of the distance by a roaring steam-engine?" But in 1827 the revenue of the Stockton and Darlington line from passenger traffic amounted to £563.

The first passenger-coach, the 'Experiment,' was a clumsy structure, like a caravan, with a table in the middle, a row of seats on each side, and a door at the back end. It began to run a fortnight after the opening of the line, and was drawn by a

single horse. It ran once daily each way. The fare was a shilling for the twelve miles, and fourteen pounds of luggage was allowed free to each passenger. Better coaches were soon built, the bodies of old stage-coaches being used for the purpose, and there were both inside and outside seats, with a corresponding variation in the fares.

At first anyone who chose to pay the prescribed rates might make use of the line independently, and several coaching companies competed with one another for the rapidly increasing passenger traffic, but as the line became more popular, this arrangement resulted in such confusion that the railway company decided to take the entire charge of all traffic.

The competition was thus described about 1850 by Mr Clephan in the *Gateshead Observer*: "There were two separate coach companies in Stockton; and amusing collisions sometimes occurred between the drivers, who found on the rail a novel element for contention. Coaches cannot pass each other on the rail as on the road, and at the more westward public-house in Stockton (the 'Bay Horse,' kept by Joe Buckton), the coach was always on the line betimes, reducing its eastward rival to the necessity of waiting patiently (or impatiently) in the rear. Difficulties, too, occurred along the road. The line was single, with four sidings in the mile, and when two coaches met, or two trains, or coach and train, the question arose which of the drivers must go back? This was not always settled in silence.

As to trains, it came to be a sort of understanding that light wagons should give way to loaded, and as to trains and coaches, that passengers should have preference over coals, while coaches, when they met, must quarrel it out. At length, midway between sidings, a post was erected; and a rule was laid down that he who has passed the pillar must go on, and the 'coming man' go back. At the Goose Pool and Early Nook, it was common for these coaches to stop; and there, as Jonathan would say, passengers and coachmen 'liquored.' One coach, introduced by an innkeeper, was a compound of two mourning-coaches—an approximation to the real railway coach, which still adheres, with multiplying exceptions, to the stage-coach type. One Dixon, who drove the 'Experiment' between Darlington and Shildon, is the inventor of carriage lighting on the rail. On a dark winter night, having compassion on his passengers, he would buy a penny candle, and place it, lighted, among them on the table of the 'Experiment'—the first railway coach (which, by the way, ended its days at Shildon, as a railway cabin), being also the first coach on the rail (first, second, and third-class jammed all into one) that indulged its customers with light in darkness."

It has been mentioned that the coaches were drawn by horses. Horse-power was used largely at first for goods traffic also, on the level parts of the line. When a down-slope was reached the horse was let loose, and ran

round to the other end of the train of wagons where there was a specially low wagon, into which he could leap. The train then ran downhill by itself, the horse contentedly munching the hay with which his wagon was supplied. One grey horse in particular was a source of pride to the railwaymen owing to its quickness. Mr Clephan tells of this horse "On one occasion, perceiving that a train which had run amain, must rush into his dandy-cart, he took a leap for life over the side, and escaped. In a similar peril, a leap over the side being impracticable, he sprung on to the coal wagon in front, and stood like an equestrian statue on a pedestal. But the time came at last when there was no escape, and the poor old grey was destroyed."

Three of Stephenson's engines were used for the coal trains from the opening of the line, and locomotive engines came gradually more and more into use. On one occasion a race took place between the 'Active,' one of Stephenson's engines, on the railroad, and a stage coach on the highroad, when the locomotive won by some hundred yards. It was thought a great achievement that it should attain the speed of ten miles an hour, the highest coaching rate. This particular engine continued to work until 1846, when it headed the procession at the opening of the Middlesborough and Redcar Railway. It may still be seen, enjoying a well-earned repose, placed on a pedestal in Darlington Station, where the

porters will expatiate proudly to the curious traveller on its still unexhausted powers.

Not the least interesting result of the Stockton to Darlington line was the almost unprecedentedly rapid growth of the town of Middlesborough-on-Tees. The town, as a matter of fact, did not entirely grow, like Topsy; it was "made-a-purpose." Mr Pease and some other members of the Society of Friends purchased between 500 and 600 acres of ground on the bank of the Tees, consisting of pasture and fallow land, and containing no habitation worthy the name except one farm-house. Their purpose was the creation of a new seaport, to relieve the congestion at Stockton. They extended the line to the site of the new town, constructed houses, docks, churches, schools, shipbuilding yards, and iron foundries; and within ten years, in place of the single farm-house, a thriving town with a population of 6000 had sprung up. Cleveland iron and Durham coal together have contributed to make Middlesborough the important seaport it is at the present day.

CHAPTER X : *Liverpool and Manchester*

SOME fifty years before the first railways were opened, there had begun to operate another great factor in the progress of civilization. This was the invention of machinery to take the place of hand-labour in the making of cotton, linen, and woollen goods. In a brief space of years, a radically different method of manufacture, working hand in hand with improved means of communication, changed the face of the country and altered its industrial and social conditions so entirely that a complete readjustment of ideas and laws was necessary, if the changes were not to bring only misery to the mass of the workers. It was in Lancashire that the interaction of these two great forces could be seen most clearly.

The first striking result of the introduction of machinery in the manufacture of textile goods was the unprecedented growth of the cotton trade in Lancashire. The cotton industry was probably started there as early as 1685 by immigrants from Antwerp, Lancashire being considered a suitable part of the country owing partly to its climate, and partly to its proximity to Ireland, whence the linen yarn then necessary in the making of cotton goods could easily be imported.

Liverpool and Manchester

After the middle of the eighteenth century, when machinery came into use, the trade increased by leaps and bounds. Raw cotton could be imported to any extent from the Bahamas and the southern states of America, and there was no lack of demand for cotton cloth. Weavers were attracted to the district in large numbers, and towns sprang up like mushrooms all over that part of the country.

The raw cotton arriving at the port of Liverpool had by some means or other to be conveyed to the manufacturing centre at Manchester. At first the rivers Mersey and Irwell had provided sufficient means of transport, supplemented later by the Duke of Bridgewater's Canal and the Leeds and Liverpool Canal. The canals paid exceedingly well, and their shareholders regarded them with complacency. Not so the manufacturers and merchants of Manchester and Liverpool. They could not get their goods conveyed in anything like the quantity required, and the canal owners, either from inability or from indifference, made no attempt to meet the ever-increasing demand for greater facility of transport.

In nine years the quantity of raw cotton sent from Liverpool to Manchester had increased by 50,000,000 pounds weight. The raw cotton would be lying sometimes for a fortnight at Liverpool, while only thirty miles away Manchester factories would be closed down for lack of material. More time was taken to transport the cotton this short

distance than to bring it all the way across the Atlantic. In winter the canals were often rendered useless by being frozen over.

At last the merchants and manufacturers could submit no longer to the anxiety and annoyance, not to speak of the financial losses, which this state of affairs entailed, and a Liverpool merchant, Mr Sandars, suggested the making of a tramroad.

Amongst Mr Sandar's friends was Mr William James, a land-agent and the owner of iron and coal mines. Mr James was an impetuous advocate of reform in many directions, and was always ready to take up a new idea. He had for long been a passionate champion of railways. He had travelled all the way to Cornwall to visit Trevithick, and to Wales to see one of his engines; he had projected a tramway near Bristol, cut a canal from Birmingham to Stratford-on-Avon, and constructed from Stratford-on-Avon to Moreton-in the-Marsh a railway with wrought-iron rails, which he intended to work by locomotives. He had other projects no less varied than ambitious, but their very variety caused many of them to prove abortive. He had no idea of giving his whole energy to one scheme for any length of time, and so the fertility of his ingenious and sometimes brilliant mind often went for nothing. As early as 1803 he had advocated the building of a railway between Liverpool and Manchester, and when in 1821 he chanced to be in Liverpool on business, he and Mr Sandars decided to make a

preliminary survey of the ground. The survey was entrusted to Mr James's brother-in-law, Mr Padley.

The surveying, however, proved no easy matter. The British public is proverbially adverse to any new idea, and on this occasion the people of Lancashire were excited even to terror by the sight of the surveyors and their instruments. This attitude of mind was not confined to ignorant farm-labourers, but showed itself in workmen, farmers, and landowners alike.

No sooner did the unhappy surveyors show themselves than they were subjected not merely to insult but to actual violence. Children shouted derogatory nicknames after them and pelted them with stones, men barred their way at every fence with pitch-forks and shovels, angrily daring them to proceed. On one occasion a chain-man was not quick enough, and was actually pitch-forked over a gate. Another was caught by some colliers and nearly thrown down a coal-pit. The theodolite was the object of the greatest savagery. In fact, so much did the surveyors fear its destruction, that they hired a powerful boxer to carry it. A champion bruiser among the colliers regarded this as a challenge, and one day attacked the instrument-bearer. There was a great fight, the colliers cheering on their man, and the surveyors looking on in mingled wrath and dismay. The collier was beaten, but the angry mob, still angrier at their champion's

defeat, pelted the unoffending instrument with stones and smashed it to atoms.

Even among educated men and in the district most to be benefited by a railway, the project was slow to win confidence. With all these obstacles to progress, the survey took a long time and was imperfect in the end.

Meantime Mr James, still hankering in his own mind after locomotive power for his railway, went over to Killingworth to see Stephenson and his engine. Stephenson was not at home, but 'Puffing Billy' was snorting along bravely, in such a way as to leave no doubt in Mr James's mind as to the efficiency of either engine or inventor. "Here," he said, "is an engine that will before long, effect a complete revolution in society." "It is the greatest wonder of the age," he wrote to Stephenson's partner, Mr Losh, "and the forerunner, I firmly believe, of the most important changes in the internal communication of the kingdom."

A week or two later, he went again to Killingworth, taking his two sons with him. This time he saw both Losh and Stephenson. The boys were afraid of the monster, thinking it would burst, but Stephenson presuaded all the visitors to mount on 'Puffing Billy,' and their fears soon gave place to enthusiasm. Mr James was convinced that Stephenson was "the greatest practical genius of the age."

Thankful to have found so powerful an advocate of their engine, Stephenson and Losh made an agreement to give Mr James one

quarter of any profits they might derive from its use on any railways that might be constructed south of a line drawn from Liverpool to Hull. In exchange for this, Mr James was to endeavour to introduce the engine to the notice of the public by writing or otherwise.

The survey was finally completed, although it had been found impossible to make it by any means a thorough one. The next difficulty may be said to have been Mr James's temperament. His volatile disposition led him to make facile promises, the fulfilment of which was too often delayed or forgotten. So it came about that in spite of repeated pressure and reminders, he failed to produce the plans and estimates necessary to the introduction of the Railway Bill, not only for the parliamentary session of 1823, but for that of 1824 also, and for a time the progress of the scheme was at standstill.

CHAPTER XI: *Obstacles to Progress*

MEANWHILE no improvement had taken place regarding the conveyance of cotton between Liverpool and Manchester, and those whose interests were most affected felt that the exisisting state of affairs could be endured no longer.

Mr Sandars, in conversation and by means of a pamphlet which he published, continued to press the idea of a tramway worked by horse-power. In 1824 a hundred and fifty Liverpool merchants signed a public declaration that "the present establishments for the transport of goods are quite inadequate, and that a new line of conveyance has become absolutely necessary to conduct the increasing trade of the country with speed, certainty, and economy." A committee was formed, which presently held a public meeting at Liverpool to discuss the best means of transport. The possibility of cutting a third canal was ruled out owing to lack of water; finally a railroad was decided on. The question remained by what power it was to be worked.

No less than three visits were paid to Killingworth to examine Stephenson's engines. The Stockton to Darlington line, then in process of construction, was also visited. On the third visit, in January 1825, one of the

locomotives drew 54 tons at the rate of seven miles an hour, and later the party of twenty (consisting of engineering experts and members of the Railway Committee) was carried at between ten and twelve miles an hour. This was considered by engineers the highest possible speed consistent with safety.

The prospectus of the scheme had by this time been published. It set forth, though in measured terms, the advantages to be derived from the creation of a double line of railway between the two cities. These advantages, however, were all in the direction of the speedy and cheap transport of goods; passengers were mentioned only in a kind of postscript.

Mr. James's delay in supplying the plans had become seriously annoying: moreover his financial difficulties were such that for some months he was imprisoned, and afterward had to leave the country. Since he was no longer able to carry out his scheme, Mr. Sandars felt that a new engineer must be found, and who could be more suitable for the post than George Stephenson? Accordingly he received the appointment in 1824. On the 25th May of that year Mr Sandars wrote to Mr James: "I think it right to inform you that the Committee have engaged your friend George Srephenson. We expect him here in a few days. The subscription list for £300,000 is filled, and the Manchester gentlemen have conceded the entire management. I very much regret that, by delays and promises,

you have forfeited the confidence of the subscribers. I cannot help it. I fear now that you will only have the fame of being connected with the commencement of the undertaking."

As the first survey was not satisfactory, another was undertaken, again by Mr Padley, with Robert Stephenson as head assistant.

This time opposition was met with again, not only from the farmers and labourers, but from such men as Lord Derby and Lord Sefton, who disliked the idea of the railway passing through their land.

The surveyors, who could not themselves use violence, sometimes managed to outwit their opponents by strategical methods. On one occasion they showed Lord Sefton's farmers a document, purporting to be the copy of a minute passed by the Old Quay Canal Company, in which land owners were urged to allow the survey to be made, so that the Canal Company could afterward find errors in the scheme and defeat it.

Another time on a moonlight night the surveyors set some of their men to fire off guns on a part of the Duke of Bridgewater's estate some distance from the ground they wished to survey. Hearing the shots, the keepers rushed off, as they thought to capture poachers, and the surveyors were free to carry on their work.

Nevertheless, work thus hastily done, with the attention constantly distracted, could not be other than imperfect. Robert Stephenson

afterward described some of their troubles before a Parliamentary Committee on the Liverpool and Manchester Bill. He said: "I was threatened to be ducked in the pond if I proceeded, and of course we had a great deal of the survey to take by stealth, at the time when the people were at dinner. We could not get it done by night; indeed we were watched day and night, and guns were discharged over the grounds belonging to Captain Bradshaw, to prevent us."

This Mr Bradshaw was the manager of the Duke of Bridgewater's property, and the most thoroughgoing opponent of the railway. He would consent neither to enlarge the Duke of Bridgewater's Canal, nor to reduce the charges. He refused to take shares in the railway, saying simply when these were offered, "All or none!" The canal owners knew that it was impossible to cut a third canal, since the two already in existence exhausted the available supply of water; they knew of the failure of the Wandsworth to Croydon Railway; they cared nothing for the good of Lancashire or of the country's trade in general; and they saw no reason why they should not continue to enjoy their enormous profits undisturbed.

When their intimidations still failed to turn the Railway Company from its purpose, the canal proprietor began to circulate pamphlets and to write to the papers. Farmers were told that horses would be needed no longer, and in consequence there would be no sale

for oats and hay; landowners were told that the smoke and steam from the engines would poison the air and kill pheasants and other birds; dwellers near the proposed line were warned that their cows and hens would be killed and their houses burnt by the fire and smoke; and the general public was informed that if they dared to commit themselves to the care of the railway they would inevitably be blown to pieces.

Even Stephenson's own friend, Nicholas Wood, said as late as 1825: "It is far from my wish to promulgate to the world that the ridiculous expectation, or rather professions, of the enthusiastic speculist will be realized, and that we shall see engines travelling at the rate of twelve, sixteen, eighteen, or twenty miles an hour. Nothing could do more harm towards their general adoption or improvement than the promulgation of such nonsense."

All honour to the *Scotsman* newspaper—probably the "enthusiastic speculist" referred to—for its admirable series of articles, published in 1824, in which complete confidence was expressed in the powers of the locomotive, and its future employment for both goods and passenger traffic was foretold. In these articles the editor, Mr Charles Maclaren, expressed his conviction that a speed of twenty miles an hour could easily be attained, and would cost little more than a speed of one mile.

"We have spoken," he said. "of vehicles

travelling at twenty miles an hour; but we see no reason for thinking that, in the progress of improvement, a much higher velocity might not be found practicable. Tiberius travelled two hundred miles in two days, and this was reckoned an extraordinary effort; but in twenty years hence, a shopkeeper or mechanic, on the most ordinary occasion, may probably travel with a speed that would leave the fleetest courser behind." These were daring words.

Passenger traffic indeed was seldom mentioned by the most sanguine upholders of the railway. As has been said, only one paragraph in the company's first prospectus referred to it at all: "Moreover, as a cheap and expeditious means of conveyance for travellers, the railway holds out the fair prospect of a public accommodation, the magnitude and importance of which cannot be immediately ascertained."

Sir John Barrow, writing to Mr Sandars on the best way of conducting the case in Parliament, advised him to rest his case on the necessity of some fresh means of transport in addition to the canals, not to lay any stress on the idea of steam-power, and not even to mention passenger-traffic. The probable speed of the engines, he thought, should not be put higher than five miles an hour, and as to passengers, if they were spoken of, "You will at once raise a host of enemies in the proprietors of coaches, post-chaises, innkeepers, etc., whose interests will

be attacked, and who, I have no doubt, will be strongly supported; and for what? Some thousands of passengers, you say—but a few hundreds, I should say—in the year."

So Stephenson, who wanted to put the anticipated speed at twenty miles an hour, twice the rate of the fastest coach, had perforce to hold his tongue. "I had no one to tell my tale to," he said afterward, "but Mr Sandars, of Liverpool, who did listen to me, and keep my spirits up, and my schemes were at length carried out only by dint of sheer perseverance."

It may be recalled, as some sort of excuse for the general attitude, that only forty years previously the journey from Liverpool to Manchester had been a serious undertaking, for the accomplishment of which a whole day had to be set aside. A paragraph in the *Manchester Herald* for 15th April, 1817, describes the journey: "The short space of time in which the opposition coaches now run between Manchester and Liverpool bring to our remembrance the difference of travelling in the years 1774, when there was only one coach between these towns, from whence it proceeded alternately, three days each week. It set out from the Spread Eagle in Salford at six o'clock in the morning, drawn (for 'running' was not then applied to coaches) by six horses under the guidance of a coachman and two postilions. The passengers breakfasted at Eccles; at Warrington, by the assistance of two extra horses, on a part of

the then very vile road, they arrived to dinner; they drank tea at Prescot; and about nine o'clock at night concluded their tedious day's travel by arriving at Liverpool."

The *Quarterly Review*, which did acknowledge the necessity for a railway, nevertheless still said of a similar scheme for a railway at Woolwich: "What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling twice as fast as stage-coaches! We would as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congreve's ricochet machines, as trust themselves to the mercy of such a machine going at such a rate. We will back old Father Thames against the Woolwich Railway for any sum. We trust that Parliament will, in all the railways it may sanction, limit the speed to eight or nine miles an hour, which we agree with Mr Sylvester is as great as can be ventured on with safety."

It would be unfair, however, to cite this passage without noting at the same time that on the point of speed the *Quarterly* was merely expressing the common opinion of the time, while the general tone of its article was as highly favourable to the railway as it was denunciatory of the attitude of the canal proprietors and landowners.

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CHAPTER XII: *The Liverpool and Manchester Bill*

CONSTRUCTING the railway was not merely a case of overcoming practical difficulties and privately convincing opponents. The railway had to receive the sanction of parliament before any works could be set on foot. Committees of the House of Commons and the House of Lords must be convinced that the new venture was not likely to prove dangerous to the public or inimical to the general good. The engineer in particular had to be prepared to answer questions concerning not only the general plan of the railway and the suitability of the chosen route, but also regarding technical matters such as the geological character of the country traversed, and small details as to bridges, etc. It must first be proved that a railway was advisable, and then that it was practicable. The first proposition was easily demonstrated; the second proved a stumbling-block.

The Liverpool and Manchester Bill went into Committee of the House of Commons on the 21st March, 1825. Its opponents had by their wealth and influence been enabled to gain the services of many of the most brilliant barristers of the time. A whole month was given up to taking evidence as to the inadequacy of the existing system.

Then came the evidence as to the practicability of a railway worked by locomotive power. It was on this that the whole case hinged.

George Stephenson was called into the witness-box on the 25th of April. It was a great ordeal for the downright, unscholarly man. He had never lost his strong North-Country accent, and the 'burr' peculiar to Northumberland was so marked as to make it difficult for the South-Country ear to follow him at all. He had for some time been conscious of this disadvantage, and had thought of having lessons in correct pronunciation, as may be seen from a letter written by the kind Quaker, Mr Richardson, to a school-master in Peckham: "Dear Friend,—My friend George Stephenson, a man of first rate abilities as an engineer, but of little or no education, wants to consult thee or some other person to see if he cannot improve himself—he has so much Northumberland dialect, etc. He will be at my house on sixth day next, about 5 o'clock, if thou could make it convenient to see him. Thy assured friend, Thos. Richardson."

Stephenson himself, speaking long afterward of his trying time in the witness-box, said: "When I went to Liverpool to plan a line thence to Manchester, I pledged myself to the directors to attain a speed of ten miles an hour. I said I had no doubt the locomotive might be made to go much faster, but that we had better be moderate at the beginning. The director said I was quite right;

for that if, when they went to Parliament, I talked of going at a greater rate than ten miles an hour, I should put a cross upon the concern. It was not an easy task for me to keep the engine down to ten miles an hour, but it must be done, and I did my best. I had to place myself in that most unpleasant of all positions—the witness-box of a Parliamentary Committee. I was not long in it before I began to wish for a hole to creep out at! I could not find words to satisfy either the Committee or myself. I was subjected to the cross-examination of eight or ten barristers, purposely, as far as possible, to bewilder me. Some member of the Committee asked if I was a foreigner, and another hinted that I was mad. But I put up with every rebuff, and went on with my plans, determined not to be put down."

Stephenson laboured indeed under many disadvantages. He found great difficulty in expressing his ideas, clear though they were in his own mind; his hearers could barely understand his speech, or, unfamiliar as they were with the subject, his meaning. There was no man and very little experience to support him, and it was easy for the clever, cultured lawyers to ridicule and sneer at the untaught workman.

He was severely cross-examined by Mr Alderson, who had made a special study of the subject. The chief points on which he was questioned were as to the slipping of the wheels, the possibility of accidents, and the

speed. The question of speed gave the most trouble. Asked whether it would not require a stronger railroad to carry the same weight at twelve miles than at four miles an hour, he replied: "I will give an answer to that. I daresay every person has been over ice when skating, or seen persons go over, and they know that it would bear them better at a greater velocity than it would if they went slower; when they go quick, the weight in a measure ceases." "Is that not upon the hypothesis that the railroad is perfect?" "It is," said Stephenson firmly, "and I mean to make it perfect."

Mr Alderson had laid so much stress on the "twelve miles on hour" that Mr Joy, the company's own counsel, became alarmed lest the contemplation of this terrific speed might lose them the Bill. He therefore re-examined Stephenson himself, bringing out the fact that, execpt for short distances, Stephenson's own engines had not as yet exceeded five or six miles an hour.

When the case for the company's opponents was entered upon, some remarks were made that appear amusing when viewed in the light of later knowledge, as that it would be impossible to start a locomotive in a gale of wind!

As regarded accidents, Stephenson stated that no accident had occurred with any of the fifty-five steam-engines (including sixteen locomotive engines) that he had built, excepting that on one occasion a man and a boy

had been scalded owing to a tube having become worn out. One of the Blenkinsop engines in use near Leeds had blown up, but that was the fault of a drunken driver.

Then as to the danger of curves, Mr Alderson asked: "Do not wrought-iron rails bend; take Hetton Colliery for instance?" "They are wrought-iron, but they are weak rails." "Do you not know that these bend?" "Perhaps they may bend, not being made sufficiently strong." "And if they are made sufficiently strong, that will involve an additional expense?" "It will." "Then if you were to make them of adamant, that would be very expensive?" "It does not require a very great expense to make them strong enough for heavier work; I mean the difference between making them for easy work and heavy work is not great." "You say that the machine can go at the rate of twelve miles an hour; suppose there is a turn on the road —what will become of the machine?" "It would go round the turn." "Would it not go straight forward?" "No." "What is to be the plan of the road, and the height of the rail?" "That has nothing to do with it." "I ask you, what is to be the height of the flanch of the wheel?" "One and a quarter inch." "Then if the rail bends to the extent of an inch and a quarter, it will go off the rails?" "It cannot bend; I know it is so in practice." "Did you ever see forty tons going at the rate of twelve miles an hour?" "No, I have not seen it; but I have seen the engine

running from eight to ten miles round a curve." "What was the weight moved?" "I think little, except the engine—the weight of the engine itself." "Do you mean to tell us that no difference is to be made between those forty tons after the engine, and the engine itself?" "It is scarcely worth notice." "Then, though the engines might run round, and follow the turn, do you mean to say that the weight after it would not pass off?" "I have stated that I never saw such a weight move at that velocity; but I could see at Killingworth that the weight was following the engines, and it is a very sharp curve; I believe they came down very frequently at the velocity of fully ten miles an hour; it is a sharper curve there than I should ever recommend to be put on any railroad." "Have you known a stage-coach overturn when making not a very sharp curve, when going very fast?" "That is a different thing; it is top-heavy." "Do you mean to say, none of your wagons will be top-heavy?" "They will not; perhaps they may get a good deal of cotton upon them; but I should construct the carriages so that they should not be top-heavy."

A little later in the evidence, Stephenson gave a reply that has since become famous. One of the Committee asked: "Suppose, now, one of these engines to be going along a railroad at the rate of nine or ten miles an hour, and that a cow were to stray upon the line and get in the way of the engine;

would not that, think you, be a very awkward circumstance?" "Yes," replied Stephenson, "very awkward indeed—for the coo!" So no more was said on that point.

The great point, however, was the impossibility of laying a railway over Chat Moss. This was an enormous peat-bog, twelve square miles in extent, some part of which would have to be crossed by the proposed line. At the time of the preliminary survey it was in such a wet condition that the surveyors could do no more than stand on the edge of it. It was impossible further in to find a part solid enough for the theodolite to stand upon. One day Mr James himself actually began to sink in the moss, and only just saved himself by lying down and then rolling quickly over and over until he found himself on firm ground.

The chief witness, Mr Giles, an experienced engineer, stated that in his opinion a railroad could not be made over Chat Moss without going to the bottom of the Moss. "No engineer in his senses," according to Mr Giles, "would go through Chat Moss if he wanted to make a railroad from Liverpool to Manchester," and it must be acknowledged that he had some warrant for this view. He described the Moss in support of his opinion: "The surface of the Moss is a sort of long, coarse, sedgy grass, tough enough to enable you to walk upon it, about half-leg deep; underneath that, on putting an iron into the soil (a boring-rod), it will, with its own weight,

sink down. In the centre, where this railroad is to cross, it is all pulp from the top to the depth of 34 feet; at 34 feet there is a vein of 4 or 6 inches of clay, below that there are 2 or 3 feet of quicksand; and the bottom of that is hard clay, which keeps all the water in. The boring-rod will get down to the first vein of clay by its own weight; a slight pressure indeed will get it to the additional depth of 2 or 3 feet beyond, which you must use more pressure to get it down to the foundation. In my judgment a railroad certainly cannot be safely made over Chat Moss without going to the bottom of the Moss. The soil ought all to be taken out, undoubtedly, in doing which, it will not be practicable to approach each end of the cutting, as you make it, with the carriages. No carriages would stand upon the Moss, short of the bottom. It will be necessary to take the Moss completely out at the bottom, in order to make a solid road."

This evidence, and that of other experienced professional engineers, proved most prejudicial to the cause of the railway. Moreover, although Stephenson's evidence was satisfactory enough so long as the questions related directly to steam engines and rails, subjects with which he was so familiar that no cross-examination could trip him up, when geological technicalities were introduced, or very close questions asked about the confessedly imperfect survey, he became hesitating and confused. He was neither a rapid thinker nor glib in

speech, he was always conscious of his own shortcomings in scientific education, and where there was any doubt in his own mind he let his adversary score rather than make a statement of the truth of which he was not absolutely certain.

Such hesitation gave Mr Alderson a great advantage when he came to sum up. His speech lasted for two days. He characterized the project as "the most absurd scheme that ever entered into the head of man to conceive." "My learned friends," he continued, "almost endeavoured to stop my examination; they wished me to put in the plan, but I had rather have the exhibition of Mr Stephenson in that box. I say he never had a plan—I believe he never had one—I do not believe he is capable of making one. His is a mind perpetually fluctuating between opposite difficulties; he neither knows whether he is to make bridges over roads or rivers, of one size or of another, or in what way the thing is to be carried into effect. Whenever a difficulty is pressed, as in the case of a tunnel, he gets out of it at one end, and when you try to catch him at that, he gets out of it at the other." On the subject of Chat Moss Mr Alderson said, "Having now, sir, gone through Chat Moss, and having shown that Mr Giles is right in his principle when he adopts a solid railway, and I care not whether Mr Giles is right or wrong in his estimate, for whether it be effected by means of piers raised up all the way for four miles through Chat Moss, whether they are

to support it on beams of wood or by erecting masonry, or whether Mr Giles shall put a solid bank of earth through it—in all these schemes there is not one found like that of Mr Stephenson's, namely, to cut impossible drains on the side of this road; and it is sufficient for me to suggest and to show that this scheme of Mr Stephenson's is impossible or impracticable, and that no other scheme, if they proceed upon this line, can be suggested which will not produce enormous expense. I think that has been irrefutably made out. Everyone knows Chat Moss, everyone knows that Mr Giles speaks correctly when he says the iron sinks immediately on its being put upon the surface . . . There is nothing, it appears, except long sedgy grass, and a little soil, to prevent its sinking into the shades of eternal night. I have now done sir, with Chat Moss, and there I leave this railroad."

Other speeches were made on behalf of the canal companies, one of the speakers describing Stephenson's evidence as "trash and confusion." Even Mr Adam, speaking for the Bill, felt called upon to excuse Stephenson's "rashness" and "want of caution."

The final result was the defeat of the Bill, after a contest lasting for two months. This was the darkest time of all George Stephenson's life. The opposing counsel had spoken so contemptuously of his ideas—not stopping short, in fact, of personal abuse—that even some of his friends no longer felt such faith in him. Moreover, the surveyors who

had been employed were incompetent, and Stephenson told Mr Sandars he feared one of them "had been fee'd by some of they canal proprietors to make a botch of the job."

The promoters of the Bill, however, were determined not to resign their project, and on the advice of Mr Huskisson they decided to bring it before Parliament again the following year.

A new survey was made, avoiding game preserves and parks, with the object of conciliating the large landowners; the use of the locomotive was not to be insisted on, and Messrs George and John Rennie were appointed engineers in Stephenson's place. Comfort came to Stephenson later in the year in the acknowledged success of the Stockton and Darlington line, but that was not for some months.

The Bill came before Parliament again in March, 1826, and was carried by a majority of 47—88 votes to 41. The successful passing of the Bill was due mainly to the support of Mr Huskisson, who had been its firm friend throughout.

CHAPTER XIII: *Conquering Chat Moss*

NOW that the much-discussed Bill had at last become an Act, the first question for the directors was the appointment of a resident engineer. Naturally they wanted George Stephenson; but they wished also to retain Messrs Rennies' services, for the sake of the experience and reputation of those gentlemen.

Mr George Rennie was willing to accept the appointment, but he wished to limit his personal superintendence to six visits in the year, and at the same time to be considered as the resident engineer. This proposal was declined, and George Stephenson was appointed chief engineer at a salary of £1000 a year.

He took a house in Liverpool, and from that moment until the completion of the railway, every plan, every yard of rail, every payment of the humblest workman employed, came under his direct superintendence.

The magnitude and variety of the work he had to do can scarcely be appreciated at this date. Had there been even a comparatively small body of skilled mechanics available, a load would have been taken from his shoulder, but no such feat of engineering had ever been undertaken before, and very few experienced men were to be had. All the

workmen had to be not merely directed but actually trained by Stephenson himself.

Then he must bear in mind that as soon as the line was completed, locomotives, wagons, and carriages must all be in a state of readiness to be placed on the rails. The building of these thus formed another and an important item to which he must attend.

Added to this were the difficulties which had to be overcome in the construction of the line itself, which by most men would have been considered insurmountable.

The length of the line was only thirty miles, but in that short distance the railway had to pass under a city, through hard rock, across a deep valley, over dozens of roads and streams, and somehow or other, no one but George Stephenson could see how, across the formidable four miles of soaking bog.

The wages offered were good, and workmen came from all parts of the country, but chiefly from Ireland and the north of England. Thus was created the modern navvy. Many of them were men of extraordinarily fine physique, and in that and many other characteristics they resembled the pitmen, or workers in the pit of a colliery, as distinct from those employed above-ground at the pit-head. Like them, the navvies were for the most part without education or the desire for it, they needed large quantities of good food to enable them to stand the very hard labour; when they got their pay they commonly spent it at once, largely on drink; they were always rough

"make yourselves masters of principle,—persevere—be industrious, and there is no fear of you." No superficial glibness or dodging of the point could deceive him; he would be down on them with, "Ah, you know naught about it now; but think it over again, and tell me the answer when you understand it." Then he would tell them of his own early struggles, ending with, "Ah! ye young fellows don't know what wark is!"

He seldom wrote his letters himself, but dictated them to his secretary. From want of practice in youth it was always difficult for him to express his thoughts on paper; but his dictated letters are admirable; clear, manly, and to the point, like his talk.

In these days of continuous hard work he would have been badly off without his good wife. She had the gift which blesses some women of making a home wherever she went; she was always kind and encouraging, and though she did not often take part in the conversation herself, it was not from lack of understanding or interest.

On the thirty miles of railway there were no fewer than sixty-three bridges. The building of a railway bridge presented fresh problems, since sudden inclines must be avoided. Some of the bridges were straight and some oblique or 'skew.' In several cases a novelty was introduced in the use of cast-iron for beams and girders. Near Manchester the river Irwell had to be crossed, which necessitated a fairly long bridge. But the most

important of the bridges was the Sankey viaduct, built over the Sankey brook and canal. It was made of brick, with stone facings, and consisted of nine arches, 70 feet high, of 50 feet span each.

Owing to the opposition of the landowners near Liverpool, the original plan had to be altered, and instead of going round the hills, the railway had to be made over and through them. At one point a cutting had to be made through solid rock. This was the Olive Mount cutting, two miles in length and sometimes as much as 100 feet in depth. The cutting out and removing of 480,000 cubic feet of stone was a stupendous task.

What was an even greater undertaking, however, was the making of a tunnel a mile and a quarter long beneath Liverpool itself. The rock had to be cut or blasted according to its kind and degree of hardness at different points. Once Stephenson, coming to inspect progress, found the men all outside the tunnel sullenly refusing to go on with the work. On demanding the reason he was told that they had just escaped being buried beneath a mass of sand that had fallen suddenly from the roof of the tunnel. Stephenson wasted no time on commands or persuasion, but simply went into the tunnel himself, and it was not long before all the men had followed him.

But of all the varied undertakings which the new line necessitated, none was comparable to that of crossing Chat Moss. The Moss, as has been said, was a huge peat-bog. Its

foundation was of sand and clay, and the mosses of which it was composed had gone on year by year forming new growth on the top of the old. The old part remained, changed in colour but only partially decayed, preserved by the peat, until at that period the moss was in parts almost thirty feet deep. The absorbent properties of sphagnum moss are well known, and are so great that after heavy rains the surface of the bog could be seen to have risen. The whole Moss was highest in the middle, and sloped down gradually in every direction to the edge. Michael Drayton gave it as his opinion that the Moss was a remnant of the Flood! All attempts at draining it had hitherto proved fruitless.

The most definite attempt at cultivating any part of the Moss had been made by Mr Roscoe, whose method of shoeing his plough-horses had been governed by the same reasoning that now influenced Stephenson. He had screwed into the horses' feet flat pieces of board, the result being that the weight of the horse rested on a much greater area than before, and consequently, the weight being distributed over a larger surface, no one inch of the ground on which it stood would feel the pressure so strongly, and the animal would be much less likely to sink. This plan embodied the leading idea of Stephenson's mode of working at Chat Moss. He argued that if his railroad were sufficiently large it could float on the top of the Moss without incurring any

more danger than a ship on the sea.

Immediately after his own appointment Stephenson had selected three resident engineers to take charge of different sections of the line—Mr Joseph Locke, Mr Allcard, and Mr John Dixon. It was Mr Dixon who had the unenviable position of superintending the part of the line that was to cross Chat Moss.

By the time he arrived, planks had been laid across the Moss, marking out the line, and the men had begun to cut drains on either side. The first time Mr Dixon walked across the scene of his future labours he slipped off a plank and the next moment was struggling waist-deep in the bog. He was quickly pulled out by the workmen, but the accident so much discouraged him that he almost turned back and gave the whole thing up. However, Mr Locke, who was acting as guide, told him that he had now passed the worst part, and he kept on, wet and brown with peat as he was. The men worked with 'pattens' or clogs on their feet similar to those Mr Roscoe had used for his horses.

The road then was to be of the nature of an enormous raft, floating on the peat-bog. But how to begin? It would not do for the men working at the road to be in constant danger of sinking, and to have to attend all the time to their own steps. First of all then, a sort of road was made, following the intended route, by laying down thick tufts of heather. To make this road the workmen had to stand on planks, laying each additional

plank in front of them as they moved along. Now they had some width of road to stand on, and the next step was to lay down a temporary single line of railway three feet wide, along which light wagons could run containing the materials for the permanent road. The wagons were small and carried only one ton each; they were pushed along by boys, who soon became so expert at the business that they could run all the way across in half an hour without missing a step; and well for them that they could, for a single mis-step would have precipitated them into the bog.

The sight of these wagons running across safely gave confidence to workmen and directors alike—a great matter to George Stephenson, for some of the directors even now had not complete faith in him.

Next, drains were dug on either side of the line, but the workmen set to dig them had an irritating task, for no sooner were the drains made than the thick bog-water came oozing in again from the sides and bottom, and their work seemed all undone. At last, Stephenson had some empty tar-barrels sent him from Liverpool to serve as drain-pipes. As the drain was dug, barrels were placed in it end to end before it had time to fill up again. They were then fixed and nailed together and covered with clay. Between the drains, where the permanent road was to be, twigs and branches were laid on the heather, and in especially soft places rafts or hurdles roughly

made with wood were placed, interwoven with heather to fill the gaps. On this foundation sleepers and rails were laid, and the sleepers were packed with turf and heather. So far, well; but when the eastern or Manchester edge of the bog was reached and the men attempted to make an embankment, they found that the dried moss with which they intended to form it simply sank through the surface and disappeared into the greedy jaws of the bog. Load after load was emptied and still it disappeared, and still the bog gaped for more.

Then indeed poor Mr Dixon wished the superintending of this part of the line had been assigned to anyone but to himself. Every fortnight he had to go to Liverpool for the money to pay his men's wages, and on a chart of the line hanging in the directors' room he had to fill in, in colour, the amount of ground worked on since the previous fortnight. But at this period there never was any additional ground covered, and the unfortunate engineer could only tell the directors that the men were still trying to fill in the same bit of the embankment.

The directors grew more and more agitated. What would it cost, they asked him, to fill up the moss from the bottom? The sum he named so staggered them that they even began to suggest the total abandonment of the scheme. Stephenson alone remained firm in the assurance of its ultimate success.

Mr Cropper, one of the directors, said to him

one day, "Now, George, thou must get on with the railway, and have it finished without further delay: thou must really have it ready for opening by the 1st day of January next." "Consider the heavy character of the works, sir, and how much we have been delayed by the want of money, not to speak of the wetness of the weather: it is impossible." "Impossible!" cried Mr Cropper, "I wish I could get Napoleon to thee—he would tell thee there is no such word as 'impossible' in the vocabulary," "Tush!" returned Stephenson, "don't speak to me about Napoleon! Give me men, money, and materials and I will do what Napoleon couldn't do—drive a railroad from Liverpool to Manchester across Chat Moss!"

Wild rumours spread abroad. People in Manchester were told triumphantly by the stage-coach drivers that Chat Moss had been blown up, and on another occasion that all the men and Stephenson himself, the drivers' arch-enemy, had been sunk in the bog and "railways were at an end for ever!"

Years afterward, speaking of this troublous time Stephenson said: "After working for weeks and weeks in filling in materials to from the road, there did not appear to be the least sign of our being able to raise the solid embankment one single inch; in short, we went on filling in without the slightest apparent effect. Even my assistants began to feel uneasy, and to doubt of the success of the scheme. The directors too spoke of it

as a hopeless task, and at length, they became seriously alarmed, so much so, indeed, that a board meeting was held on Chat Moss to decide whether I should proceed any further. They had previously taken the opinion of other engineers, who reported unfavourably. There was no help for it, however, but to go on. An immense outlay had been incurred; and great loss would have been occasioned had the scheme been then abandoned, and the line taken by another route. So the directors were compelled to allow me to go on with my plans, the ultimate success of which I myself never for one moment doubted."

Stephenson stuck to his favourite motto, "Persevere!" and by dint of filling and filling with dried moss and turf, they at last began to see some result for all their labours and finally the embankment was made; a thin brown road stretched across the Moss, and from the insulted bog there flowed a peaty stream, forced out by the pressure of the turf.

Owing to the resiliency of the bog foundation, the road over the Moss proved to be one of the easiest-running parts of the line, and strange to say it was also one of the cheapest. On new Year's Day 1830 it was first crossed by a passenger train.

CHAPTER XIV: *Robert's Life in Colombia*

WHILE George Stephenson was struggling with the difficulties of the Liverpool and Manchester Railway, Robert was leading a somewhat exciting life in South America.

He had gone out as superintendent of the Colombian Mining Association of London. His instructions were to prospect for gold and silver mines in the Andes, and when he reached a district rich enough in the precious minerals to open up the ground and start operations at once.

His journey of 1200 miles from the coast to Bogota was made on mule-back, under very different circumstances from those of his old donkey-rides to school.

He was amused at the sight of his own figure clothed for travelling, as he himself describes it, in "a hat made of plaited grass with a crown nine inches in height surrounded by a brim of six inches, a white cotton suit, and a *ruana* of blue and crimson plaid, with a hole in the centre for the head to pass through. This cloak is admirably adapted for he purpose, amply covering the rider and mule, and at night answering the purpose of a blanket in the net-hammock which every traveller carries before him on his mule, and

suspends to the trees or in houses, as occasion may require.

As they proceeded inland, the road rose higher and higher, and soon the burning heat of the plains and their scanty dried-up grasses gave place to fresh mountain air and luxuriant vegetation. Before them the magnificent mountain range of the Cordilleras drew them ever westward. To the end of his life Robert Stephenson never forgot the wonderful grandeur of those evenings when the peaks stood out black against such sunset skies as his bare Northumberland moors never saw, when later the sudden twilight, deepened into the still more sudden night, and the southern stars blazed in the deep blue of the tropical sky.

The spot on which he finally decided to start his mining operations was Santa Anna, where long ago Spanish adventurers had found silver and gold wherewith to load their galleons. Here a little house was built for him close to the forest. The walls were of bamboo, the roof of palm-leaves, and in front was a little verandah from which in the evenings he could gaze his fill at the heights of the Andes towering before him.

The romance of the scenery and the gorgeous colouring of birds and insects and flowers might have made the young Englishman feel that he was living in a story-book, had it not been for the very stern prosaic practical difficulties connected with his work. First, the native workmen were lazy and shiftless and had to be constantly watched, then other

mining associations tried to ruin the one that he represented; then when at last a company of miners arrived from England, they quarrelled and rebelled, and on every possible occasion got drunk; worst of all Robert himself became ill with fever. At one time the boy—for he was hardly more, still only twenty-one—almost felt that, alone as he was, he would never be able to succeed. However, he was both determined and resourceful. He had ingratiated himself with the native workmen by feeding them, and with their superiors by giving a ball; for dealing with the English miners sterner measures were needed, but he overcame their troublesomeness also in the end.

None the less he had no wish to remain after the three years for which he had contracted to stay, and he was glad and proud to find that his father was as anxious to have him back in England as he himself was to get there.

Indeed his presence was needed. Mr Pease wrote to him, "I can assure thee that the business at Newcastle, the engineering factory, as well as thy father's engineering, have suffered very much from thy absence, and, unless thou soon return, the former will be given up."

Robert left in August 1827, but his adventures were not yet over. While he was waiting for a ship at Cartagena, he noticed one day a tall thin man dressed almost in rags, and very wretched looking. Robert could see that he was English, and when he spoke to the stranger he found to his great astonishment

that it was no other than Richard Trevithick, the brilliant and unfortunate inventor of the first railroad locomotive.

Sitting in the bare public room of the hotel he told Robert Stephenson his story. He had been mining in Peru, at first with immense success, but in consequence of the revolution by which the Peruvian people freed themselves from the Spanish yoke, and established a republic, Trevithick's native miners were all taken away to fight, and after the revolution had been accomplished, the royalist party accused him of having helped the patriots, and avenged themselves by breaking his engines and destroying his machinery. Trevithick and one of his friends fled from Peru, toiling over great mountains, pushing their way through tropical forests, swimming deep rivers.

They were glad to escape with their lives, and indeed they had little else left. Wearied and half-starved, with no property except the torn and ragged clothes they stood in (and a pair of silver spurs!), Trevithick and his friend at last reached Cartagena. Even in that desperate plight Trevithick's buoyant hopefulness had not deserted him, and he told Robert Stephenson he was going back to England to start another company which, without doubt, would make his fortune. Robert lent him £50, and they took passages in the first ship for New York. Their adventures were not yet at an end, however, for after a stormy passage the ship was wrecked, and they barely succeeded in saving themselves and their property.

Robert's life in Colombia

Trevithick's chequered career ended in 1833 in his sixty-second year. He died £60 in debt, and would have been buried by the parish but for a subscription raised by his then employers and their workmen.

In November Robert Stephenson arrived in Newcastle, where his first task was to straighten the accounts of the engineering factory. It was not long before he succeeded in bringing the business once more into good working order.

CHAPTER XV: *The 'Rocket'*

STRANGE to say, although the Liverpool and Manchester Railway was by this time in an advanced state, the directors had not even yet decided the vexed question as to the kind of power to be used—horse or locomotive.

After many meetings had been held and the problem had been exhaustively discussed, the balance of opinion was found to be againts the employment of horse-power. After some of the directors had visited the Stockton and Darlington railway, the idea of horse-power was definitely abandoned.

Still it had not yet been decided whether locomotive or fixed engines should be used. On this point the directors found themselves unable to come to any decision. Everyone in Britain, France, and America who had any scheme whatever for any method of traction hastened to say his plans before them—and very crack-brained schemes some of them were.

George Stephenson consistently advocated the stheam locomotive, running on smooth wheels, but no other engineer was to be found who would say a word in its favour. The professional engineers, jealous of Stephenson's powers, and contemptuous of his lack of approved training, for the most part would not take the trouble even to examine his engines.

He persisted, however, so unweariedly that at last the directors allowed him by way of an experiment to build an engine for temporary use on the railway, at the same time expressing their confidence in his ability.

This engine was used for hauling stone during the construction of the line.

A second visit to the Stockton and Darlington line, and to Killingworth, was not productive of much result, for the visiting members of the company could not agree as to the relative merits of the locomotive and the fixed engines.

Finally since the question had to be decided one way or another, the directors requested two wellknown engineers, Mr Rostrick and Mr Walker, to examine the railways in Durham and Northumberland, and make a full report. So a third inspection was made, with the strange result that both engineers gave their verdict in favour of fixed engines. They advised the directors to divide the line into nineteen stages of about a mile and a half each, and to have altogether twenty-one fixed engines.

Stephenson had never stood so entirely alone. The engineers and the public were against him, even his old friend Nicholas Wood had not much confidence in his engines, though indeed he might have had more courage, for he had seen the Killingworth engine at work for fifteen years. Nevertheless, Stephenson himself never lost faith, and never ceased to put forward the claims of his

engines. He showed that the working expenses of fixed engines would be greater, and of locomotive engines less, than had been estimated.

He laid particular stress, however, on two points—first, that if fixed engines were used, a breakdown at any one point would derange the working of the whole system, whereas with locomotives, in the case of an accident to one engine, another could easily be substituted at once without interrupting the traffic; and second, that the engineers had not understood the principle of the steam-blast in his engines, since they had maintained that if the engine ran at a great speed the steam would become exhausted, whereas the fact was that on the contrary the quicker the speed the greater the production of steam.

On receiving the engineers' report, the directors wished to make immediate preparations for putting the fixed engine scheme into practice, but Mr Sandars, true to his belief in Stephenson, maintatined that before they committed themselves to so large an outlay of capital, they should at least give their own engineer the opportunity of showing them what his engines were capable of doing.

Had Stephenson been less confident, or less courageous and persevering, there is no doubt that even then, after seeing his extraordinary success in the construction of the line, the directors would still have passed by his achievements in the building of locomotives;

but he persisted that if he were given time and opportunity he could fulfil all their requirements, and at last they decided to give the locomotive a fair trial. To this end they offered a prize of £500 for the best locomotive engine which should fulfil certain conditions, as follows:

1. The engine must effectually consume its own smoke.

2. The engine, if of 6 tons weight, must be able to draw after it, day by day, 20 tons weight (including the tender and water tank) at 10 miles an hour, with a pressure of steam on the boiler not exceeding 50 lb. to the square inch.

3. The boiler must have two safety valves, neither of which must be fastened down, and one of them be completely out of control of the engine-man.

4. The engine and boiler must be supported on springs, and rest on six wheels, the height of the whole not exceeding 15 feet to the top of the chimney.

5. The engine, with water, must not weigh more than 6 tons; but an engine of less weight would be preferred on its drawing a proportionate load behind it; if of only 4½ tons, then it might be put on only four wheels. The company to be at liberty to test that boiler, etc., by a pressure of 150 lb. to the square inch.

6. A mercurial gauge must be affixed to the machine, showing the steam pressure above 45 lb. per square inch.

7. The engine must be delivered complete and ready for trial, at the Liverpool end of the railway, not later than the 1st of October, 1829.

8. The price of the engine must not exceed £550.

The competition was to be judged by Mr Rostrick, Mr Kennedy of Manchester, and Nicholas Wood.

It evoked great interest, but not very much confidence was felt in its result, though few people went so far as Mr Ewart of Liverpool, who announced that if ever a locomotive were found to go at 10 miles an hour, he would eat a stewed engine-wheel for breakfast.

Robert Stephenson and his father had plenty to discuss in their evening talks. It was a great matter for Stephenson to have someone always at hand on whose judgment and sympathy he could rely, and whose daring and sagacity equalled his own. Together they made many experiments before they finally constructed an engine which satisfied their hopes.

The main point being to produce steam as rapidly as possible, their experiments were connected chiefly with the attempt to increase the heating surface. The simplest method seemed to be merely to lengthen the boiler. This was done, but it proved to be insufficient. Stephenson's next idea was to have a double longitudinal tube in the boiler, each tube containing a fire. He built two engines with double tubes, but although they worked well

they could not serve as models for his competition engine, since they weighed about 12 tons.

Before this time several inventors, Trevithick among them, had designed and patented tubular boilers of various kinds, though as a rule the inventors seem only to have made plans or models, and not to have incorporated the multitubular boiler in an actual working engine. In most of these boilers the tubes themselves contained water or steam, and the fire passed around them, but the opposite method of having water in the boiler and heat passing through the tubes was adopted by M. Seguin, the engineer of the Lyons and Saint-Etienne Railway, and by Mr Booth, secretary of the Liverpool and Manchester Railway. M. Seguin had actually used his boiler in two engines built at Stephenson's works for the Saint-Etienne Railway, but the tubes became furred and did not last long. Mr Booth's invention was taken up eagerly by the Stephensons, who had copper tubes made in Newcastle for the purpose. The tubes were soldered to brass screws, which were screwed into the ends of the boiler.

George Stephenson himself was in Liverpool when the boiler was fitted up, so it fell to Robert to test it. He had the boiler filled with water, and pressure applied, and stood eagerly awaiting the result. But alas for his hopes!—the water came steaming out, and soon he was standing ankle-deep in it, ruefully surveying his precious engine.

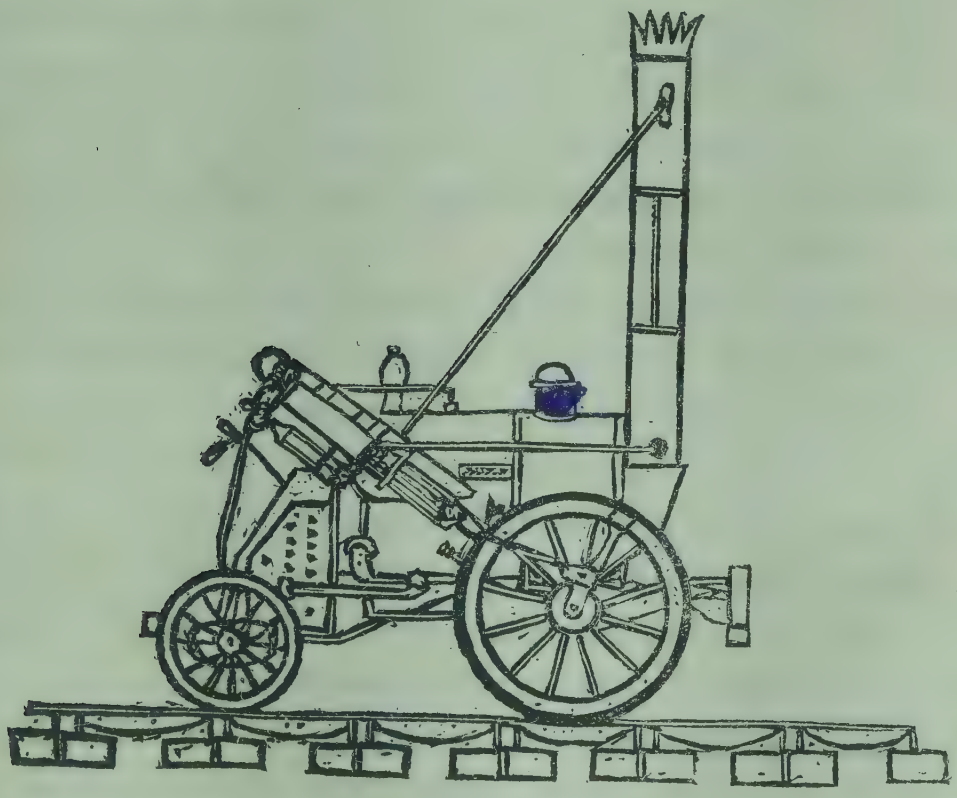
He was so bitterly disappointed that he wrote a despairing letter to his father, telling him that the tubes were useless. However, before George's reply came, urging him as usual to persevere, he had recovered his courage and had thought of the very plan which his father suggested in his letter—to dispense with the screws, and simply fix the tubes into holes in the boiler ends, making them fit as closely as possible, and soldering to prevent leakage. The risk of leakage would be obviated further by the expansion when heated of the copper tubes. This was done, and no more trouble was given by the tubes.

Another improvement on Stephenson's previous engines was made by increasing the effect of the steam-blast. This was accomplished by contracting the orifice by which the waste steam escaped into the chimney; thus the velocity of the air in the chimney was increased. In this engine there were two blast-pipes opening from the cylinders into the chimney, and both were made with the ends contracted.

The engine was named 'The Rocket.'

Its appearance has been made familiar to the ordinary traveller by the tiny brass models of it which have been placed in many stations, and which may be made to work by "putting a penny in the slot." It had a tall narrow chimney and a small boiler (6 feet long) which was half filled with water, the upper half being left for the steam. The heat passed from the fire-box through twenty-five

copper tubes which were fixed in the lower half of the boiler. Behind the boiler was the little fire-box, only 2 feet wide, which was surrounded with water. On each side of the boiler was a cylinder, placed obliquely, its lower end pointing to the middle of the wheel with which it was connected. There were two pairs of wheels, uncoupled, the front pair being the smaller. The tender contained the coal and a cask of water, and was also mounted on four wheels. The whole engine weighed little more than 4 tons.



THE 'ROCKET'

CHAPTER XVI: *The Triumph of the 'Rocket'*

THE day of the competition came at last. It had been postponed to the 6th of October, to give the competitors a little more time. There were four competitors:

1. Messrs Braithwaite and Ericsson, with the 'Novelty.'
2. Mr Timothy Hackworth, with the 'Sanspareil.'
3. Mr Robert Stephenson, with the 'Rocket.'
4. Mr Burnstall, with the 'Perseverance.'

Other engines had been partially built with the intention of competing, but only these four were ready in time.

The competition took place at Rainhill, on a level piece of ground about two miles long. The competing engines were to make the double journey from one end of the course and back, twenty times, at a speed of not less than ten miles per hour. To facilitate the judging it was intended that each engine should be tested on a different day.

An enormous crowd assembled to view the competition, not only engineering experts and Lancashire manufacturers, but people from distant counties who were interested in commerce or in the general progress of their country, and fashionable ladies in a grandstand erected for the occasion.

The Triumph of the 'Rocket'

The day was passing and the crowd was eager for the exhibition to begin, but the 'Novelty' and 'Sans-pareil,' the first two engines on the list, were neither of them quite ready for the contest, so the 'Rocket,' which characteristically enough was in perfect order, was allowed to make a short run by way of experiment and to allay the growing impatience of the spectators. It ran 12 miles in rather less than an hour.

Late in the day the 'Novelty' was announced as ready for trial, but owing to some doubt as to its proper load it was not tested on this day, merely running a mile or two at the rate of about 24 miles an hour. It was a small, light engine, with the water and fuel on the same wheels as the engine. In this engine bellows were used to force the air through the fire.

The 'Sans-pareil,' built by Mr Hackworth, the locomotive foreman of the Stockton and Darlington Railway, was exhibited but not tested. It was similar to Stephenson's engines already in use on the Stockton and Darlington line, but with the draught increased by the greater contraction of the orifice of the blast-pipe into the chimney.

On the second day of the contest, while the 'Novelty' was getting up steam in preparation for its trial, the bellows gave way and the engine could do nothing. The 'Sans-pareil' too was in need of repairs to its boiler; so again the 'Rocket' was called out to prevent too great disappointment to the assembled

crowd. This time much excitement was caused by Stephenson's attaching a coach to the engine and taking thirty passengers for a short trip at the wonderful rate of 24 to 30 miles an hour.

The next day was that properly assigned to the 'Rocket' for its test. On this occasion the spectators had not to stand waiting and have their expectations unrealized. Early in the morning the 'Rocket' was brought out; it took an hour to get up steam, and then started on its run. Wagons weighing 13 tons were attached to it, and thus loaded it performed the first ten trips backward and forward in an hour and forty-eight minutes, and the second ten in two hours and three minutes. At one part of its journey it attained the speed of 29 miles an hour, and its average rate was 15 miles.

The amazement of the spectators and the gratification of the directors can be imagined. As the 'Rocket' finished its last return journey Mr Cropper, one of the directors, exclaimed: "Now has George Stephenson at last delivered himself! As for the Stephensons themselves, this was one of the most satisfactory days in their lives.

On the 10th an advertisement appeared to the effect that the 'Novelty' would be tested on that day, and would perform more work than any engine upon the ground—an ill-timed boast, for though the 'Novelty' started out in good style, it had run only two miles before it was stopped by the bursting of a

pipe. The pipe was repaired, and later in the day the engine alone ran some distance at the rate of from 24 to 28 miles an hour.

When on the 13th the 'Sans-pareil' was ready, its weight was found to be beyond that specified in the conditions of the competition. It was allowed to run and accomplished eight trips at 14 miles an hour, with its load; at that point, however, it broke down, and was refused the second trial asked for it next day, owing to its extraordinary consumption of coal. Mr Hackworth, in his enthusiasm for the steam-blast and the narrowed orifice, had gone too far and contracted the pipe to such an extent that much of the coal was blown out and wasted.

The fourth engine on the list, Mr Burnstall's 'Perseverance,' was out of the running on account of its low speed, not more than 6 miles an hour.

On the 14th, therefore, which had been announced as the day for the prize-giving, only the 'Novelty' and the 'Rocket' remained to compete. The 'Novelty' was given another chance, but again broke down, so that the 'Rocket' was left in full possession of the field, and the prize of £500 was awarded amid acclamations to the Stephensons.

The 'Rocket' on that day ran without a load at 35 miles an hour.

The soundness of the workmanship put into the little engine was proved by the fact that years later, after a life of hard work, it was capable of attaining a speed of 60 miles an

hour. It was found small and light, and had to give place to heavier engines, but in itself it was an excellent piece of work, and the best monument to the Stephensons' industry and perseverance.

Its first employment was to haul gravel for the permanent way across Chat Moss, and on New Year's Day 1830 it drew the first passenger train across the Moss.

CHAPTER XVII: *The Opening of the Liverpool and Manchester Railway*

THE year 1829 happened to be a wet one, and the progress of the works had been somewhat impeded by the rains, but by June of 1830 the line was practically completed, and in that month a trial trip was made, when the 'Rocket' drew the directors from Liverpool to Manchester and back, taking two hours to go and one and a half to return, and crossing Chat Moss at 27 miles an hour.

When the Liverpool tunnel was finished it was lit up with gas, and the public was allowed to inspect it on one day a week, at a shilling a head.

Finally, on the 15th of September the line was publicly opened. The importance of the occasion, as not merely an event of local interest, but a landmark in the progress of civilization, was fully recognised, and it was celebrated with fitting ceremony. Among those who attended the opening were the Duke of Wellington, Prime Minister, Sir Robert Peel, Secretary of State, and Mr Huskisson, an M.P. for Liverpool, who had been largely instrumental in securing the passing of the Act.

All along the route were thousands of

enthusiastic spectators, and the utmost care had been taken to prevent accidents. A railway was such a novel thing, and so few people realized that a train could actually run at 24 miles an hour, that there might have been danger of the eager crowd pressing on to the track itself, if the directors had not taken the percaution of fencing it in, and posting soldiers and policemen along the line to keep it clear.

In preparation for the event eight engines built in Stephenson's factory at Newcastle had been brought over, and thoroughly tested on the line. These eight, with their loads of carriages containing altogether about 600 persons, formed the opening procession. At the head was the "Northumbrian,' driven by George Stephenson, and following it in order the 'Phœnix,' by Robert Stephenson, the 'North Star,' by Robert Stephenson senior (George's brother), the 'Rocket,' by Joseph Locke, the 'Dart,' by Thomas L. Gooch, the 'Comet,' by William Allcard, the 'Arrow,' by Frederick Swanwick, and the 'Meteor,' by Anthony Harding. All these men had been connected with Stephenson in the construction of the line, and the honour of driving the engines was a fitting reward for their hard work.

Unfortunately, despite the care that had been taken to prevent accidents, the day was marred by tragedy. When the trains, were within 17 miles of Liverpool they stopped to water the engines. The Duke of

Wellington was travelling in the first train and it remained standing on one line, while the rest of the procession passed along the other line before the Duke's carriage. Mr Huskisson had alighted from the train, and was standing on the line, when the Duke, seeing him, held out his hand. Mr Huskisson pressed forward the more eagerly as he and the Duke had recently been somewhat estranged. They were shaking hands when a cry of "Get in! Get in!" caused Mr Huskisson to step back in confusion. The door of the carriage was open, and as he was trying to get round it, the 'Rocket' ran him down, causing him to fall on the line in such a way that his leg was crushed by the wheel. He was taken to a house near by, where he died the same evening. His body was carried by the 'Northumbrian' engine at the rate of 36 miles an hour, a speed surpassing any hitherto attained.

After this sad accident, no one felt in the mood for festivity, and the Duke of Wellington and Sir Robert Peel wished the procession to return to Liverpool immediately. Such a proceeding, however, was thought to be both selfish and unwise. Crowds were awaiting the arrival of the trains in Manchester, and their non-arrival, together with the exaggerated reports that would be certain to be made, would have caused wild alarm and prejudiced the success of the line to an incalculable extent. The celebrations could not take place in the way that had been

intended, but the Duke agreed that the procession should go on to Manchester, returning as soon as possible.

The line was a complete success from the first. As in the Stockton and Darlington line, very little passenger traffic had been expected, but in this respect the company's calculations proved very wide of the mark, for in place of the 500 passengers a day which they had given as the limit of their expectations, more than 1200 a day were carried even at the beginning, and the number increased rapidly; in fact the profits were derived mainly from passenger traffic.

There was another important respect in which prophecy proved mistaken, and that was regarding the speed. Most people, even experienced engineers, had regarded 10 miles an hour as the utmost that could be expected, or that could even be considered safe, but from the first the passenger trains ran often at about 25 miles an hour, and their average speed was 20. They took an hour and a half for the single journey of 30 miles, which had needed four hours by stage-coach. Two Edinburgh engineers writing to the *Scotsman* marvelled at having observed the passengers, "among whom were a good many ladies, talking to gentlemen with the utmost sang-froid," and this at the astonishing speed of 25 miles an hour.

The railway did not oust the canals, but it caused them to make an immediate and considerable reduction in their charges. As a

matter of fact the railway could not at once have taken over more than a fraction of the goods traffic, for it had not enough engines.

It is amusing to read the remarks of the landowners *before* and *after* the opening of the line. Some of those who had opposed it most strenuously, and so effectively as to cause it to deviate from the original plan in order to avoid their estates, were very soon complaining bitterly that it did not pass over their land. Far from being driven away from the neighbourhood of the line, people were found building as close to it as possible; rents near the railway rose quickly, and even Chat Most was soon brought under cultivation.

After the line had been working for a year and a half, two charges were brought against Stephenson in an article in the *Edinbourgh Review*; that he had obtained a monopoly of the engines supplied to the railway, and that he employed as workmen on the line men whom he knew personally in preference to local men. Both these charges were true, but if the circumstances are considered neither of them gave just cause for complaint.

As regards the engines, although Stephenson was the engineer of the line, the directors had shown no unfair preference for his engines. The competition was entirely above-board, and no undue advantage had been given to the 'Rocket.' After the line was opened, other locomotive builders besides Stephenson were given the chance of having their engines

adopted. Two engines were ordered from Messrs Braithwaite and Ericsson, the builders of the 'Novelty,' but these and others being found unsatisfactory, the directors naturally decided to keep to Stephenson's engines, on which they knew they could confidently rely. Stephenson was by no means satisfied to keep on making engines after the pattern of the 'Rocket.' He was constantly on the watch for defects and as constantly devising improvements and putting them into practice. This was acknowledged by the writer of the article, who owned that 'the engines have been constantly varied in their weight and proportions, in their magnitude and form, as the experience of each successive month has indicated. As defects became manifest they were remedied; improvements suggested were adopted, and each quarter produced engines of such increased power and efficiency that their predecessors were abandoned, not because they were worn out, but because they had been outstripped in the rapid march of improvement." Since this was admitted, the 'monopoly' was surely justified. In any case it was merely temporary, and existed at all simply for the same reason as the subject of the second charge—Stephenson's partiality for workmen that he knew. The simple fact was that Stephenson's own factory in Newcastle, as being the first engineering factory in the country, was still the only place where either satisfactory engines could be built or qualified workmen could be trained. When other firms grew up and

produced reliable engines, orders were given to them as well as to the Stephensons. As to the selection of workmen, that charge seems now almost ludicrous. The labourers living in the parishes through which the line passed knew nothing of this new kind of labour, and the object being to make the line a thorough piece of work, it followed that workmen were employed who would be likely to attain that end. Therfore Stephenson naturally selected as foremen and skilled workmen those who had been trained under his own guidance at Newcastle, and for a long time Newcastle men were usually chosen as engine-drivers, not only on the Liverpool and Manchester line but on succeeding railways all over England, and even on the Continent. But as it was necessary to employ altogether 600 men to work the line, the Newcastle factory could supply only a tenth of the total number, and the bulk of the labourers were drawn from a wide field.

It has been mentioned that Stephenson continued to devise improvements, which he embodied in successive engines. Among these improvements were the coupling of the wheels in the engine, making them firmer on the rails; the closer fixing of the fire-box to the boiler; the reduction by various means of the quantity of coke consumed; the invention of spring frames for the carriages; and the introduction of buffers to prevent bumping. As the weight of the engines, the length of the trains, and the speed at which they travelled all increased,

stronger rails had to be laid down. By such continued application of new ideas travelling by rail was soon made safer, quicker, and more comfortable.

CHAPTER XVIII: *Further Progress*

WITH the triumph of the 'Rocket,' the romance of Stephenson's career may be said to have ended. Henceforth he was a prosperous man, and his schemes were almost assured beforehand of success. The swimmer in calm seas excites no such sympathy and absorbed interest as he who is yet struggling with the waves and being buffeted against the rocks. Yet there is an interest attached to the later part of Stephenson's life too, apart from the interest not so keenly felt at this date in the extension of railway systems, with which he was closely connected. Men's characters are tested in divers ways; for some poverty is the severest trial of all; for others, among them some of the finest natures, dangers and difficulties and the petty annoyances of a poor man's daily life act as spurs, or even, to use Jeremy Taylor's stronger word, "allurements"; there are few whose inner tranquillity "fortune's buffets and rewards" alike are powerless to disturb. George Stephenson had been tried by opposition, and now prosperity was to have its turn.

Now that the public had been convinced of the thorough practicability and utility of locomotive railways, the new idea was taken up enthusiastically all over the country. The

question of the nationalization of railways, however best answered, was apparently one which needed some hundred years for consideration; in any case the Government of the day was far too busy endeavouring to improve the condition of the existing turnpike roads—which certainly needed improvement if ever anything did—to do anything in regard to railways but allow much time and money to be wasted over each railway bill. Under these circumstances the only thing to be done was for those who had the capital, and were willing to take risks, to construct railways as a private enterprise. The first two railway companies, the Stockton and Darlington and the Liverpool and Manchester, were joint-stock companies, and those that followed were of the same type. Some companies had already been formed before the opening of the Liverpool and Manchester line, notably that for a six-mile railway between Canterbury and Whitstable, for which Stephenson's assistants, Mr John Dixon and Mr Locke, acted as surveyor and superintendent respectively. This line was opened in 1830, and worked partly by Stephenson's locomotives and partly by fixed engines.

The next lines to be constructed were branches of the Liverpool and Manchester line, and one of these which ran south to Warrington was continued to Birmingham as the Grand Junction Railway, and engineered by Stephenson. He was also engineer of a cross-country line from Manchester to Leeds,

commercially a very important undertaking. Another important line was that from Birmingham to London, of which George and Robert Stephenson were appointed joint engineers. This last-named line was to pass Northampton, but so great was the panic of the inhabitants at such a notion that the line had perforce to take a more devious route, necessitating a tunnel 2400 yards long beneath the Kilsby Ridge. It was not so very long before a branch line had to be made to Northampton, but the enforced change of plan shows the extent to which opposition still existed. Landowners in Hertford and Buckinghamshire, together with all those who had any connexion with stage-coach travelling, displayed hostility in much the same way as the opponents of the Liverpool and Manchester railway. Again surveys had to be made at night by the light of dark lanterns. A certain clergyman, through whose property the line was to go, was so violently antagonistic that the wily surveyors approached the grounds in force just before service time, and as soon as the clergyman was safely in church entered, and having arranged their plans beforehand managed to complete the survey before the service was over. In 1831 the survey was finished, Robert Stephenson himself having walked over the country between London and Birmingham twenty times in order to make sure of the best route. Although care had been taken so far as possible to avoid parks, the great mass of landowners was still as

hostile as ever. Encouragement was given, however, by the changing attitude of the general public, by the conversion of Lord Derby and Lord Sefton, who had been among the most influential opponents of the Liverpool and Manchester line, and by the fact that the Grand Junction Canal Company refrained from financing the opposing side.

The Bill was brought before Parliament in 1832, and passed the Commons by a large majority; the witnesses for the Bill were examined at length on purpose that the public might be informed of the truth. It was a different matter when evidence was taken before a Committee of the House of Lords. The landowners had determined beforehand that the Bill should not be passed, and after an unsuccessful attempt at bribing the directors, the Bill was thrown out. During the following session it was passed without any difficulty, "the most active and formidable opponents having been," in the words of the company's circular, "conciliated." The explanation of this pleasingly vague term is to be found in the fact that in place of the original estimate of £250,000 in payment for the required land, £750,000 was actually paid by the company.

The line was 112 miles long, and its final cost was £5,000,000. It was divided, and the parts let to contractors, some of whom had great difficulties to contend with, since the workmen were mostly untrained and some of the work was of an entirely novel character. The most difficult part was the Kilsby Tunnel.

Further Progress

This tunnel had to be made 160 feet below the surface, and shafts were sunk in several places so that the contractor might know what kinds of rock or soil he had to deal with, and estimate the cost accordingly. The estimate was £90,000, and the contractor began work. Sir F. Head in *Stokers and Pockers* tells of the troubles that awaited him: "The work was in busy progress when, all of a sudden, it was ascertained that, at about 200 yards from the south end of the tunnel, there existed, overlaid by a bed of clay 40 feet thick, a hidden quicksand, which extended 400 yards into the proposed tunnel, and which the trial shafts on each side of it had, almost miraculously, just passed without touching.

"The traveller in India could scarcely be more alarmed at the sudden sight of a crouching tiger before him than the contractor was at the unexpected appearance of this invincible enemy. Overwhelmed at the discovery, he instantly took to his bed, and though he was liberally, or, to speak more correctly, justly relieved by the company from his engagement, the reprieve came too late, for he actually died!

"The question then arose, whether, in the face of this tremendous difficulty, the execution of the Kilsby Tunnel should be continued or abandoned. The general opinion of the several eminent engineers who were consulted was against proceeding, and certainly the amount of the difficulties which was subsequently incurred justified the verdict. But in

science, as well as in war, the word 'impossible' can occasionally, by cool and extraordinary exertions, be divested of its first syllable, and accordingly, Mr Robert Stephenson offering, after mature reflection, to undertake the responsibility of proceeding, he was duly authorized to do so.

"His first operation was of course to endeavour by the power of steam-engines—the comrades of his life—to lower the water with which he had to contend; and although, to a certain degree this attempt succeeded, yet by the draining of remote spring, and by the sinking of the water in wells at considerable distances, it was soon ascertained that the quicksand in question covered several square miles.

"The tunnel, 30 feet high by 30 feet broad, arched at the top as well as the bottom, was formed of bricks laid in cement, and the bricklayers were progressing in 'lengths' averaging 12 feet, when those who were nearest the quicksand, on driving into the roof, were suddenly almost overwhelmed by a deluge of water which burst in upon them. As it was evident that no time was to be lost, a gang of workmen, protected by the extreme power of the engines, were, with their materials, placed on a raft, and while with the utmost celerity, they were completing the walls of that short length, the water, in spite of every effort to keep it down, rose with such rapidity that, at the conclusion of the work, the men were so near being jammed against

the roof that the assistant engineer, Mr Charles Lean, in charge of the party, jumped overboard, and then, swimming with a rope in his mouth, he towed the raft to the foot of the nearest working shaft, through which he and his men were safely lifted up into daylight, or as it is termed by miners, 'to grass.'

"The water now rose in the shaft, and, as it is called, 'drowned out' the works. For a considerable time all the pumping apparatus appeared to be insufficient. Indeed, the effort threatened to be so hopeless, that the directors of the company almost determined to abandon it, but the engineer-in-chief, relying on the power of his engines, prayed for one fortnight more. Before that period expired, science triumphed over her subterranean foe, and—thanks to the inventor of the steam-engine—the water gradually lowered.

"By the main strength of 1250 men, 200 horses, and 13 steam-engines, not only was the work gradually completed, but during night and day, for eight months, the astonishing and almost incredible quantity of 1800 gallons per *minute* from the quicksand alone was raised by Mr Robert Stephenson, and conducted away!"

No wonder the cost of the tunnel was nearly four times the estimate! The cost of the whole railway, indeed, was double the amount anticipated. This was partly owing to various sums which the landowners managed to extort from the company. For example, finding they were legally entitled to accommodation bridges,

they demanded many, and afterward offered to do without the bridges provided the company would pay them the value in cash. This they did to avoid extra labour. However, there is no need to waste pity on the company, for the line paid excellently from the first, and if the cost exceeded the estimates, so did the profits, to an even greater extent.

CHAPTER XIX: *Busy Years*

IN 1830, in the course of his work as engineer of the Leicester and Swarmington Railway, Robert Stephenson saw what seemed to him unmistakable evidence, of the existence of coal near the line. The estate of Snibston, in which the presumed coal-fields lay, was then for sale, and Robert wrote to his father suggesting the advisability of buying it, and working the coal. George Stephenson went to inspect the ground, and agreed that the coal was there. The estate was near Ashby-de-la-Zouche and fourteen miles from Leicester. Leicester had hitherto used Derbyshire coal, brought by canal, and it was obvious that if good coal could be mined at Snibston, the new railway and the town of Leicester would provide a cheap means of conveyance and an excellent market. Moreover, Stephenson's further residence in Liverpool was unnecessary, since the railway had been opened and was presenting no difficulties in the working. In conjunction with two Liverpool friends he accordingly purchased the Snibston estate in 1831, when his old favourite Bobby had the honour of drawing his master and mistress to their new home.

A pit was sunk at once, and though the operations were twice hindered, first by water and then by a worse obstacle in the shape of granite, they were continued steadily until at the end of nine months the principal

seam of coal was reached. Stephenson was in his element, and introduced into his colliery many improved methods of working, which were new to the district and were copied with his hearty encouragement by neighbouring owners. The market was as good as had been expected, the people of Leicester being glad enough to obtain their coal at a much cheaper rate than heretofore, when heavy transport charges had kept up the price.

A village soon grew up near the mine, and since Stephenson was the guiding power, every cottage had a little garden. He also had a church, chapel, and schools built, and encouraged his workmen to give their children a good education.

Although now fifty years of age, Stephenson was still in his vigorous prime. His physique was excellent, and he could go to sleep at any time when a rest was possible. He was thus enabled to get through an amount of hard mental and physical work that most men would find impossible. Indeed, his secretary—for he now had a secretary—wished sometimes that he were not quite so strong, for he could dictate letters for hours on end. He once dictated continuously for twelve hours, when the exhausted secretary's strength gave out. Stephenson himself, from want of practice in his younger days, never got over the difficulty he found in writing letters, but he knew what a business letter or a report should be, and when dictating he was able to think quickly and clearly, and to express

himself concisely. His correspondence was all connected with planning or surveying new railways, estimating their cost, or endeavouring to have the Bills passed by Parliament.

But his correspondence, his colliery at Snibston, and the locomotive factory at Newcastle took up only a small fraction of his working hours. In the one year 1836 he was principal engineer of five important railways: the North Midland, from Derby to Leeds; the York and North Midland, from Normanton to York; the Manchester and Leeds; the Birmingham and Derby; and the Sheffield and Rotherham. He was thus under the necessity of constantly travelling to and fro, and very little of his time was spent at his home at Alton Grange. Most of the travelling, of course, was by post-chaise. It is worth while to read a list of his journeys for a few weeks, bearing in mind that this was no extraordinary period, but his usual mode of life for, at any rate, the three years 1834-37.

"August 4th—Travelled from Alton Grange to Burton, and on to the Foxhall summit on the Birmingham and Derby Railway; then to Ingestre Hall, to examine Lord Talbot's salt-works, and thence to Lichfield. August 5th—Lichfield to Birmingham, to examine the ground for the terminal Station of the Birmingham and Derby Railway; then on to Derby. August 6th—Engaged at Derby all day with the Corporation, conferring with them as to the site of the station for the

Birmingham and Derby and Midland Railways, then examining the Holmes, and journeying home by Burton.

"August 9th—Alton Grange to Derby and Matlock, and forward by mail to Manchester, to meet the Committee of the South Union Railway. August 10th—Manchester to Stockport to meet Committees of the Manchester and Leeds Railway, then to Liverpool to meet directors of the Chester and Birkenhead and Chester and Crewe Railways. August 11th—Liverpool to Woodside, to meet Committee of the Chester and Birkenhead line; journey with them along the proposed route to Chester; then back to Liverpool. August 12th—Liverpool to Manchester to meet directors of the Manchester and Leeds Railway, and travelling with them over the works then in progress. August 13th—Continued journey over the works, and arrival at Wakefield; thence to York. August 14th—Meeting with Mr Hudson at York, and journey from York to Newcastle. August 15th—At Newcastle, working up arrears of correspondence. August 16th—Meeting with Mr Brandling as to the station for the Grandling Junction at Gateshead, and stations at other parts of the line. August 17th—Newcastle to Carlisle, to inspect the Maryport line. August 18th—Carlisle, to Wigton and Maryport, examining the railway. August 19th—Maryport to Carlisle, continuing the inspection. August 20th—At Carlisle, examining the ground for a station, and working up correspondence. August 21st—Carlisle to Dumfries by rail,

forward to Ayr by chaise, proceeding up the valley of the Nith, through Thornhill, Sanquhar, and Cumnock. August 22nd—Meeting with the promoters of the Glasgow, Kilmarnock, and Ayr Railway, and journey along the proposed line; meeting with the magistrates of Kilmarnock at Beith, and journey with them over Mr Gale's proposed line to Kilmarnock. August 23rd—From Kilmarnock along Mr Miller's proposed line to Beith, Paisley, and Glasgow. August 24th—Examination of site of proposed station at Glasgow; meeting with the directors; then from Glasgow by Falkirk and Linlithgow, to Edinburgh, meeting there with Mr Grainger, engineer, and several of the Committe of the proposed Edinburgh-Dunbar Railway. August 25th—Examining the site of the proposed station at Edinburgh, then to Dunbar by Portobello and Haddington, examining the proposed line of railway. August 26th—Dunbar to Tommy Grant's to examine the summit of the country toward Berwick, with a view to a through line to Newcastle, then return to Edinburgh. August 27th—At Edinburgh, meeting the Provisional Committee of the proposed Edinburgh and Dunbar Railway. Agugust 28th—Journey from Edinburgh through Melrose and Jedburgh to Horsley, along the route of Mr Richardson's proposed railway across Carter Fell. August 29th—From Horsley to Mr Brandling's, then on to Newcastle; engaged on the Brandling Junction Railway. August 30th—Engaged with Mr Brandling; after

which, meeting a deputation from Maryport August 31st—Meeting with Mr Brandling and others as to the direction of the Brandling Junction in connection with the Great North of England line, and the course of the railway through Newcastle, then on to York. September 1st—At York, meeting with York and North Midland directors, then journeying over Lord Howden's property to arrange for a deviation; examining the proposed site of the station at York. September 2nd—At York, giving instructions as to the survey, then to Manchester by Leeds. Sepetember 3rd—At Manchester, journey to Stockport with Mr Bidden and Mr Bourne, examining the line to Stockport, and fixing the crossing of the river there; attending to the surveys, then journey back to Manchester, to meet the directors of the Manchester and Leeds Railway. September 4th—Sunday at Manchester. September 5th—Journey along part of the Manchester and Leeds Railway. September 6th—At Manchester, examining and laying down the section of the South Union line to Stockport; afterwards engaged on the Manchester and Leeds working plans, in endeavouring to give a greater radius to the curves; seeing Mr Seddon about the Liverpool, Manchester and Leeds Railway. September 7th—Journey along the Manchester and Leeds line, then on to Derby. September 8th—At Derby seeing Mr Carter and Mr Beale about the Tamworth deviation, then home to Alton Grange. September 10th—At Alton Grange preparing report

to the Committee of the Edinburgh and Dunbar Railway."

A clear head as well as a strong body was needed to carry out a lengthened programme of this type. The above diary shows, besides George Stephenson's capabilities, the extent to which railway construction was being carried on, and the enthusiasm of the projectors of the various schemes, all of whom wished to have their lines working as soon as possible. As may be seen from Stephenson's journeys, lines were in progress in Scotland as well as in England, notably one between Edinburgh and Dunbar; and in October of the same year (1836) he was in Ireland inspecting the route of a projected railway in Ulster.

The saltworks referred to as having been examined were at Tamworth and belonged to Lord Talbot. Stephenson had suggested a way of 'tubbing off' the fresh water from the salt, which was carried out, and vastly increased the profits. His mind was always on the alert to discover new methods, and he was generous with his suggestions, liking to have his advice taken, but not with a view to pecuniary profit to himself. He regarded railways with the eye of a zealous and benevolent parent, and was chiefly anxious that the benefits they could bring should be appreciated and utilized to the full. He engineered a branch line of the Leicester Railway through Lord Stamford's property, and did it gratuitously, so that the granite

quarries there might be worked to the be advantage.

In 1836 he took an office in London fo the purpose of transacting the Parliamentar business connected with the railways. Givin evidence before Parliamentary Committee had lost its terrors, and indeed he had plenty of practice, for he had to give evidence no only for those lines of which he was engi neer, but for most of the other projecte lines also. In 1841 he told the House o Commons Committee that there was hardly a railway in England that he had not had to do with. During the busy session of 1836 Acts were passed empowering the construc tion of lines from London to many large towns, in particular Bristol, Southampton, Dover, Colchester. A line from Rugby to Derby completed the chain linking London and Newcastle.

Two of the railways for which Stephenson acted as chief engineer may be mentioned more particularly: the Manchester and Leeds, and the North Midland. The acts for both these railways were obtained in 1836. While the Bill for the Manchester and Leeds was before Parliament, Stephenson saw that the hastily taken survey could be improved upon, but the directors, although they agreed with his plans of alterations, decided to have the Act passd as originally drafted, and to bring forward a fresh Bill in the following year. This was done, and the second Bill had reached the Lords' Committee when Lord Wharncliffe,

who was averse to the line on the grounds, that it would compete with the Manchester and Sheffield line which passed through his land, interrupted Stephenson's evidence to make a speech attacking the promoters of the Bill, and accusing them of deception in having had the first Bill passed when they had privately determined not to carry it out. He ended by turning on Stephenson with, "I ask you, sir, do you call that conduct *honest*?" Probably no other word could so have stung Stephenson, who replied: "Yes, my lord, I *do* call it honest, and I will ask your lordship, whom I served for many years as your engine-wright at the Killingworth collieries, when did you ever know me to do anything that was not honest and honourable? You know what the collieries were when I went there, and you know what they were when I left them. Did you ever hear that I was found wanting when honest services were wanted or when duty called me? Let your lordship but fairly consider the circumstances of the case, and I feel persuaded you will admit that my conduct has been equally honest throughout in this matter." He proceeded to give a concise account of the two Bills, and Lord Wharncliffe signified his acceptance of it by asking that his speech and Stephenson's reply should not be recorded in the evidence. The rest of the Committee was completely satisfied, and several of its members afterward came up and shook hands with Stephenson.

The only other incident in the progress of the line that need be recorded is an accident —slight in reality but wildly exaggerated— to the Littleborough Tunnel. The tunnel was nearly a mile and three-quarters long and had taken four years to construct, although a thousand workmen were employed on it. According to the report, the whole tunnel had fallen and many of the workmen were burried beneath it. However, when Stephenson and a party of directors entered the tunnel, picturesquely preceded by fifty navvies bearing torches, they found that no part of it had fallen, only in one place the ground was wet and uneven from the pushing up of a small part of the drain. The invert had been made rather less strong at the point, since the blue shale beneath it appeared hard and firm, and the accident was caused by the unsettling of the shale. The remedy was simple— strengthening of the walls or replacing the invert more firmly. Stephenson remarked, "I will stake my character, my head, if that tunnel ever give way, so as to cause danger to any of the public passing through it." The tunnel was quickly repaired, and the whole line was opened in 1841.

The Manchester and Leeds served many important manufacturing towns, but the North Midland (from Derby to Leeds) was of greater personal interest to Stephenson. One of his great objects now was to make a continuous line from London to Edinburgh, and the North Midland would help on that work. Another

of his objects was to carry coal from the North and Midlands to London by railway, and he felt sure that coal conveyed by rail would be able to compete in price with 'sea' coal. This object also would be aided by the North Midland, which would pass through a district rich in coal mines. The transport of coal by railway was a favourite subject with Stephenson. "The strength of Britain lies in her coal beds," he said, "and the locomotive is destined, above all other agencies, to bring it forth. The Lord Chancellor now sits upon a bag of wool, but wool has long ceased to be emblematical of the staple commodity of England. He ought rather to sit upon a bag of coal, though it might not prove quite so comfortable a seat. Then think of the Lord Chancellor being addressed as the noble and learned lord *on the coal-sack*! I am afraid it wouldn't answer after all."

The North Midland was opened in 1840, but in 1838 Stephenson took on lease a colliery at Clay Cross, intending to work it for the London market, and at the same time he left Alton Grange and went to live at Tapton House, near Chesterfield. The latter was a convenient centre for his work as engineer of the Midland, the Manchester and Leeds, the York and North Midland, and the Birmingham and Derby Railways. As may be seen, Stephenson chose himself to act as engineer of the more northerly lines; Robert Stephenson had charge of those in the south. Partly also he chose Tapton House because

he was already contemplating at least partial retirement, and the situation and grounds of Tapton House promised scope to his love of gardening and breeding—a partiality which had perforce remained unsatisfied during the last busy years. Even at Alton Grange he had spent all his scanty spare time in gardening, riding through the country lanes on Bobby, discussing rural questions with the neighbouring farmers, and in his old hobby of bird-nesting. One of the few letters he wrote with his own hand told Robert how one day he noticed a robin beating its wings against the panes in a vain attempt to get into the house. Stephenson searched eagerly through the house for the nest, and at last found it in a corner of an unused room. There on the nest was the dead mother-bird sitting over her young—dead too. Stephenson let in the anxious living bird, now half inanimate from exhasution. He warmed and fed it and kept it as a pet, but its troubles had been too much for it and it soon died. It must have been trying to get in for three days, for it was so long since a servant had casually closed the window through which it had been accustomed to go in and out. The pitiful incident touched Stephenson so that he remembered it always.

CHAPTER XX: *Connexions with Scotland and Ireland*

STEPHENSON'S design of connecting London and Edinburgh seemed now to have a good prospect of being carried out. In 1836, when inspecting the projected route from Edinburgh to Dunbar, he had also examined the routes by which a line could be taken south to Newcastle. He decided on the coast route by Berwick as being the most satisfactory for several reasons, and his views on the question were expressed in a report made in 1838 to the directors of the Edinburgh and Dunbar Railway. The following extract from the report shows his characteristic style, and is also interesting as laying stress on one or two points which he considered of paramount importance in all railway construction:

"In laying out a line of railway from England to the two principal cities in Scotland, and as a great thoroughfare between the two countries, there are many circumstances to be taken into consideration. The first and most important of all, considering it as a great national work and desirable for the convenience and advantage of the whole community, is to endeavour to obtain a railway with such inclinations as will secure a certain, speedy, and safe conveyance between the two countries, not merely for the conveyance

of passengers, but more especially for the mails. We should endeavour to obtain a railway on which the engines should at all times be enabled to perform the duties required of them, without having to encounter steep inclined planes totally unfit for the profitable employment of the locomotive engine, and also without having to depend in a great measure upon the peculiar state of the atmosphere, in order to enable the engines to surmount such inclined planes at all.

"It is extremely desirable in laying out a main line of railway like this to avoid as much as possible passing through a high country, as in so doing you not only invariably meet with difficulties in the form of extensive works to be executed, and inclined planes to be overcome, but you also traverse a country much more subject to the inclemency of the weather, especially in winter, where in high countries the snow, a great impeder to railway travelling, remains so long a time upon the ground.

"In consequence of the line I propose to you running so near the coast, it is entirely free from those great disadvantages. It passes through a low country; it possesses levels of a most favourable nature; and in the neighbourhood of the sea-coast the snow remains a very short time upon the ground. The line itself runs so near the coast, that it may be found of great advantage in conveying troops from station to station, and, in case of war, in conveying despatches from the seat of Government to any part of the

North, and also for keeping up a communication with the sea. The whole troops of the country might also by its means be concentrated in one spot on the shortest notice.

"The line of railway which I am proposing will constitute the last link in the great chain of railway communication from London to Edinburgh and Glasgow. In the whole of this chain there will not be between London and Edinburgh one inclination exceeding 20 feet a mile (except at the London and Birmingham stations), and the characteristic inclination will be 16 feet a mile. The same description of engine will be enabled to work the whole of the lines included in this chain, so that, if it should be necessary, either from necessity or despatch being requisite, or in case of accident, an engine may be transferred from one line to another capable of performing the work. But, as I stated before, it appears to me that, both in a national and commercial point of view, the most important consideration in procuring easy inclinations is that it ensures a certain, speedy, and punctual performance of the duties required from the engines.

"In looking at the subject in a local point of view, I may state that it has always been my practice to lay out main lines of railway through the lowest country, unless some important consideration, such as a large and populous town, induced me to diverge into a higher country. I consider that by adopting the low country I have many advantages

which are lost by taking higher one. Considering the subject locally, I afford great facilities in procuring cheap branches from the main line into the interior of the country, and up the various valleys which run nearly at right angles to the main line; for instance, as regards the present railway, those productions, both agricultural and mineral, which are found in Northumberland and Scotland, may be conveyed on branch railways running up the valleys of the Blyth, the Wansbeck, the Coquet, and the Tweed, on declining railways from the places where they are produced to the main line of railway, where they can be carried north or south as may be required.

"It is a very important consideration indeed that branch railways should possess a falling inclination toward the main line, as the productions of the country are invariably conveyed either to the coast for shipment, or to populous towns through which the main railways of the kingdom are carried, and the traffic conveyed from populous towns and the coast into the interior of the country is generally of a light description, consisting of groceries and what may be called the luxuries of life. There is, however, in this case, an exception, and that is the river Tweed. It will be a great advantage to the valley of the Tweed, inasmuch as the inhabitants will procure both lime and coal from Berwick at a cheap rate, and as that river is crossed at the height of 90 feet, and is a sluggish stream near its mouth, you will be enabled

to have a level branch along the valley for many miles.

"The towns of Morpeth, Belford, Alnwick, and Kelso may be easily accommodated by branches up the different valleys in which they are situated.

"I will now conclude this Report, congratulating you upon the favourable nature of the country, and the great facilities which exist for constructing the works on the coast-line, with a firm conviction in my own mind that it is the only feasible and desirable line of railway, with levels to which locomotive steam can be advantageously applied, between the town of Newcastle-upon-Tyne and the cities of Edinburgh and Glasgow."

The construction of the line was postponed for some years, and this was the case also with two other lines that Stephenson reported on at about the same time—one between Leeds and Bradford, and one from Chester to Holyhead, the latter of importance as facilitating communication between England and Ireland. Stephenson intended to take passenger carriages over the Menai Bridge by horse-power in order the better to distribute the weight on the bridge. This railway was finally constructed in 1844 by Robert Stephenson, who designed in this connexion the celebrated tubular bridge over the Menai Straits.

The postponement of the construction of these three and many other lines was a result of the extra-ordinary rapidity with which railways had increased during the years 1836

and 1837. In the former years thirty-four and in the latter forty-two railway Acts were passed, though many of these were for branches of already existing lines, and the Acts represent only about a third of the projects. A new way of making money was discovered by computing the amount of traffic that might be expected on a new line, railway promoters being willing to pay for such computations, which they could incorporate in their prospectuses. The very lowest profit that might be expected according to the traffic taken would be 9 or 10 per cent., and the Eastern Counties Railway was to yield 23¼ per cent. But a vast amount of money, thirty millions, had already been spent, and two-thirds as much again had to be found in order to complete the works already started. Shareholders found that before their railway could be finished and dividends begin to come in, they themselves would have to pay out large sums. As a result the price of shares fell; at the same time Parliament made it more difficult to obtain railway Acts, and thus many projects fell to the ground or had to wait for a term of years before being realized. Between 1838 and 1843 only some dozen new lines received Parliamentary sanction, 1840 being a dead year. In 1844 railway speculation once more took the field, and in 1845 railway construction from being a solid business undertaking suddenly became an instrument for satisfying the wildest gambling mania.

CHAPTER XXI: *New Ideas in Railway Engineering*

DURING the quiet years of 1838 to 1843 a new school of engineers had been growing up, and a spirit of unrest and excitement was working. These new engineers were young men of talent, filled with the extravagant notions and unbounded self-confidence of flattered youth. What was a self-taught engine-man that his system should be the final word? Other and brilliant schemes were in their minds that should throw the plodding locomotive in the shade. Indeed it would have been a deplorable sign of lack of national vitality if the locomotive railway, so unexpectedly a success, had *not* been a spur to the general inventive faculty, and the starting-point of other systems. Only, the young inventors united to their undoubted ability neither the steady perseverance nor the single-minded honesty of purpose of the workman whom they despised. Their inventions were to bring in startling profits and to aggrandize their own reputations; thoroughness of workmanship and commercial gain were by the way. Ability was there in plenty, for the engineer of even a small railway must be no incompetent fool; the success of the undertaking was in his hands, and he had to be not only well up in practical mechanics and surveying, and in elementary

geology, mathematics, and mechanical science, but capable also of holding his own before a Parliamentary Committee—no slight test.

The new engineer took up Stephenson's pet theories one by one, contradicted them, and endeavoured to explode them. One of the chief of these theories, as has been seen, was that directness of route was of less importance than easy gradients. Wherever possible, Stephenson would construct his lines on a level stretch of country, often along a river-valley, deeming it better to go round a mile than to incur expense by cutting a tunnel through it, or to include a steep gradient by taking the line over it. To the rising generation, however, such a proceeding seemed over-prudent if not futile. Stephenson maintained that for hauling heavy loads the engine needed all its power, whereas the ascent of a stiff incline would exhaust half or even three-quarters of its power. For this reason he considered steep gradients wasteful, and argued that a line with much rise and fall on it was bound to be uneconomical, and therefore, from a commercial point of view, a mistake. The new engineers, on the other hand, considered that an 'undulating line,' as it came to be called, was no disadvantage, and some of them even insisted that such a line was preferable to a level one.

This opinion in regard to gradients arose from the great object of the younger engineers, which was to save time in travelling, an object which gave rise also to very greatly

changed ideas on the subject of speed. In a speech made at the Belper Mechanics' Institute in 1841, Stephenson remarked, "The first time I went to Parliament to give evidence on the locomotive engine, when I stated that I would make that machine travel at 12 miles an hour, I was thought to be mad. You will be surprised when I tell you that, during my recent examination before a Committee of the House of Commons on the management of railways, I stated that in my opinion the speed of the locomotive should not exceed 40 miles an hour. I have been censured by many for giving that opinion. It is true that I have said the engine might be made to travel 100 miles an hour, but I always put a qualification on this, namely, as to what speed would best suit the public. I assure you I have been buffeted about in Parliament not a little on this question of railway speed." Stephenson's objections to a rate exceeding 40 miles an hour was on the grounds of the danger attending high velocity on a railway, and also to some extent because of the additional expense incurred. Such a speed by no means satisfied the engineer of the 'fast school,' who aimed at anything up to 100 miles an hour as the average. Stephenson himself had built one engine capable of attaining 50 miles with a load, and 80 miles alone, and Robert Stephenson apparently made up his mind that if fast engines were to be the order of the day he, at any rate, would construct the fastest—which accordingly he did, his 'A' engine

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drawing a passenger train in 1845 from York to Darlington at almost 60 miles an hour.

Another fruitful cause of dissension was the question of the gauge. In fixing upon 4 feet 8½ inches as the gauge for the first railways, Stephenson had simply followed use and wont. That particular width had been the one always used in the wooden wagon-ways, and he found in practice that it was satisfactory. Another inch or two would probably have made little difference, but the important point to Stephenson's mind was that since he hoped for the continued extension of railways until a network of iron roads should be spread over the country, one line running into another, it was highly advisable that every railway company should adopt the same gauge; otherwise there would be delay and extra work at the junction of the different lines.

Some of the younger men advocated a wider gauge, and Isambard Brunel, an experienced and brilliant engineer, in planning the Great Western Railway, decided on a gauge of 7 feet. This gave rise to a prolonged controversy, known at the time as the "Battle of the Gauges." The directors, although they had acquiesced in Mr Brunel's view, when they found how much the wider gauge would increase their expenses, asked Robert Stephenson to report on the matter. He preferred not to do so, his opinion being well known, since he had reported against a wide gauge to the directors of the London and Birming-

ham line. Nicholas Wood and another engineer, Mr Hawkshaw, were then asked to make an examination and report, but though they both gave a decided verdict against the 7-foot gauge, the directors after all determined to let their engineer have his way, and the railway was constructed with the wide gauge. Mr Brunel argued that the position of the Great Western rendered it unnecessary for it to fall into step with the other railways in the matter of the gauge. He thought it would remain unconnected with other railways, and he even desired for it such a position of 'splendid isolation,' for he supposed that if the difference of gauge kept other railways from joining it, the Great Western would thus remain in full possession of all the traffic in its part of the country. This way of looking at the matter was alien to Stephenson's whole view of the raliway system. He wanted the public to be served by the railways in the best and cheapest and safest way, and to attain that end the railway system must be a national one, in the sense, that is to say, of being one system not a number of disconnected parts. Moreover, he considered that where steep curves existed the narrow gauge was safer, always a great point with him, and he knew, what in fact was obvious, that it was more economical both in building and in maintaining a railway.

For some time the Great Western met with no difficulty on the score of its gauge, but not many years had passed before branches

of the more northerly lines were formed, joining it, and then trouble at once began. Passengers were annoyed at the delay involved, but what was more important was the waste of time and money occasioned by the transfer of goods. This was felt in particular by Birmingham manufacturers who, as early as 1844, held a public meeting to protest against this "commercial evil of the first magnitude." Shortly after, a royal commission was appointed to report as to "whether, in future private Acts for the construction of railways, provision ought to be made for securing a uniform gauge, and whether it would be expedient and practicable to take measures to bring railways already constructed, or in progress of construction, into uniformity of gauge." The report was in favour of a uniform narrow gauge. It was some time, however, before the Great Western adopted the narrower gauge.

Another railway, the Eastern Counties, had chosen a gauge of 5 feet, but when they extended their line to join the Midland Railway, they altered their gauge on the advice of Robert Stephenson, and with the complete approval of their own engineer, Mr Braithwaite.

The narrow gauge was adopted on the Continental railways, also, even on the Genoa to Turin line, of which Mr Brunel was engineer. The Irish railways adopted a gauge of 5 feet 3 inches. The original gauge of the Ulster Railway was 6 feet 2 inches, as recommended

by the Irish Railway Commission; that of the Drogheda line, which joined it, was 5 feet 2 inches. Something had to be done, and General Pasley, the Government engineer, hit on the brilliant notion of taking all the authoritative opinions he could as to the most suitable gauge, and finding the average. This happened to be 5 feet 3 inches.

The most revolutionary scheme of the new school of engineers was the use of 'atmospheric tubes' in place of the locomotive engine. A large tube was to be built, the atmospheric air pumped out of it, and the train shot through by means of atmospheric pressure. The leading idea was not new, having been thought of by Papin, the French engineer. Even the notion of conveying a train of passengers by this means had been patented as early as 1824 by Mr Vallance of Brighton. Now, however, atmospheric railways were actually brought into use. The first railways to employ atmospheric tubes were the West London and the Dublin and Kingstown. They proved expensive and unreliable, and were all pulled up again by 1848. Stephenson, while admitting the ingenuity of the atmospheric railway, objected to it as 'a gimcrack' or even 'a humbug.' He never saw cause to rescind his decision on seeing a model of one in the early days of the scheme. "It won't do; it is only the fixed engines and ropes over again in another form." He based his objections on the fact of which he was assured, that such a railway would not be a

sound commercial undertaking, and he had no admiration for a railway that did not pay. He always refused to engineer a line which he thought would not be profitable.

CHAPTER XXII: *The Development of the Railway System*

EVEN after the Stockton and Darlington and the Liverpool and Manchester Railways had both proved successful, it was a long time before the inhabitants of other parts of the country overcame their prejudices and began to regard a railway as an asset commercially and a boon socially. The people of Lancashire were soon convinced, for the advantages to them were obvious. But in Maidstone such a protest was raised that the railway had to be made to pass some distance from the town, as it had had to do in the case of Northampton also. Other towns were of like mind, and the prejudice was fanned zealously by landowners and stage-coach proprietors as well as by innkeepers on the turnpike roads.

The prejudice was stronger in the south than in the manufacturing districts, which is easy to understand. "Nothing is more distasteful to me," said Mr Berkeley, Member of Parliament for Cheltenham, "than to hear the echo of our hills reverberating with the noise of hissing railroad engines running through the heart of our hunting country, and destroying that noble sport to which I have been accustomed from my childhood." The æsthetic argument, the strength of which no one would deny, has been put forward

by plenty of writers, from Ruskin downward; but it seems to have had little hold during the infancy of railways. Nearly all the arguments in vogue were based on an anticipated injury to some special class such as horse-breeders or farmers.

Objections from the point of view of public safety and public health existed too, however. "Tunnels," said the doctors, "would expose healthy people to colds, catarrhs, and consumption." On this subject both sides were equally strong in their contention, the one proving that travellers through tunnels would be poisoned or suffocated, the other maintaining and signing certificates to that effect, that the atmosphere of tunnels was "dry, of an agreeable temperature, and free from smell." Probably the public was wise enough to strike the average between these two views.

In 1831, after the opening of the Liverpool and Manchester Railway, be it noted, a proposal which now seems absurd was strongly advocated, and a House of Commons Committee appointed to report on its advisability. This proposal was to make use of the steam-engine for passenger traffic on common roads. Certainly it was agreed that the roads should be improved first, and indeed in their existing condition they were unfit for light carriages; but even a very much smoother road than any that was then to be found would necessarily cause far more friction than could be produced between wheel and

rail. Various kinds of steam-carriages were tried, and several witnesses, Trevithick among them, spoke enthusiastically in their favour, but in spite of this, and although the Committee's report was favourable also, nothing ever came of the steam-carriage project except the ruin of several people who attempted to carry it out.

Nevertheless, in 1836 a second attempt was made to introduce it, and the Commons passed an Act repealing the heavy tolls on steam-carriages. The House of Lords Committee called Stephenson among other witnesses, and he spoke decidedly against the employment of steam-engines on ordinary roads. In addition to the friction difficulty, he laid stress on the dangers. The engine could not be made heavy enough to preclude the possibility of the boiler's bursting. The Committee found Stephenson's evidence conclusive. Moreover, the steam-carriage could not fulfil the requirements of the public as to speed. Men who had travelled smoothly at thirty miles an hour between Liverpool and Manchester would not be satisfied with jolting along at ten miles an hour on a high road. So the steam-carriage died an unobtrusive death.

The opening of succeeding railways had similar effects on other parts of the country, as that of the Liverpool and Manchester had had on the north-west. Landlords and farmers found that their pheasants and cows were *not* poisoned by the smoke, that oats were in

greater demand than before; coach-proprietors needed more horses and vehicles to drive travellers to and from the stations; dwellers in towns rejoiced in the cheaper coal and fresher meat and vegetables which the railways brought them, and so far from property deteriorating in value because it was near the line, its rent went up, and it was advertised as being "close to a railway station."

The utility of railways as regarded goods traffic quickly became patent; but that they were equally a boon to passengers was soon no less so. They were cheaper than stage-coaches; they were more comfortable; they were very much quicker, and saving time meant saving money—and, strange to say, they were much less dangerous. During the first eight years of working of the Liverpool and Manchester Railway, five million passengers were taken, and only two lives were lost by accident. Stage-coaches, high and top-heavy as they were, frequently upset, and passengers were often injured and not infrequently killed. Stephenson himself was once in a stage-coach accident, when a linch-pin gave way, causing the coach to fall over. He had the presence of mind to hold himself firm by the straps and so escaped injury; but several of the passengers were badly hurt. Many people bemoaned the passing of the stage-coach, and certainly the change was in part a loss, as most changes are; but probably a large part of the lamentation was purely sentimental, and after all, if one was not in a

hurry it was still possible to travel by road. Who has forgotten Tom Brown's long cold ride to Rugby, and the numbness of his dangling feet? And how many of us so far agree with the author in his sturdy upholding of the stage-coach as to choose that method of conveyance for a long journey ourselves? No wonder the railways were popular.

One result of the railway system was to make differences in rank much less pronounced in travelling. The marquis travelled first-class, the merchant second, and the labourer third; but they rubbed shoulders at the station, and were conveyed at the same speed and with equal safety, and after a time, in almost equal comfort. This was by no means pleasant to the feelings of the aristocracy, and for some time many families, preferred to keep up their old method of travelling, using their own carriages, and changing horses at inns along the road. But the double advantage of ease and speed gradually brought them over to the railways, and when in 1842 Queen Victoria began to travel by rail to and from Windsor, such a method could no longer be deemed over-democratic.

Once railways had taken hold of the country, they increased with marvellous rapidity, until they reached the 23,000 miles that exist in the United Kingdom at the present day.

One or two points in their development may be noted. At first, passengers were booked at a railway office, and their names were written down on a way-bill which was given to the

guard. It was not long before this method was found troublesome, and tickets were introduced. Instead of the shrill whistle to which we are accustomed, the first passengers had a trumpeter at the end of the platform to play them away. The early third-class carriages were mere trucks, open to the weather, but better ones were soon made; at first only four people rode in a first-class compartment. One great change is the increase proportionally of third-class passengers. This is largely owing to the increased comfort of third-class carriages, but also to the gradual elimination of obvious 'class differences.' Only about five per cent. of the total number of passengers in this country now travel first-class.

Signals were given at first by men with outstretched arms in different positions; then by means of coloured flags; next, fixed signals were put up with arms or discs, and lastly, semaphore signals were invented. Signalling and the general safety of the travelling public have been incalculably helped by the use of the telegraph. But railway accidents have always been rare.

Engines and carriages alike gradually became larger and heavier. Where heavy traffic existed, steel rails were used.

One difference between a train and a stage-coach is that a coach, when the passengers had reached a certain number, said it was 'full,' whereas a train must be prepared to provide accommodation for any number of passengers who have taken tickets. Where

the traffic was greater than had been expected it was found easy to put on extra carriages.

Among the most striking and important effects of the railway system is the increase both in the number of towns and in the size of those that previously existed. The latter result, of increase in the size of towns, is now rightly deplored on all hands; but it is not to be attributed to railways only, but to our whole modern industrial system.

Whether railways have improved the world, as viewed from any standpoint other than the commercial one, is a question that it is futile to ask, for railways cannot be considered in isolation. They themselves were the result of the altered conditions of industry and trade brought about by the introduction of machinery, and had George Stephenson never lived, they would have come sooner or later in some similar form. They are only a part of the general modern atmosphere of speed and competition, part of a stage through which civilization apparently had to pass.

CHAPTER XXIII: *Railway Speculation*

IN the days when railways were with difficulty struggling into existence, they were controlled by men of such sterling integrity as Edward Pease and Mr Sandars, and subscribed for by manufacturers who would benefit directly by them, and by disinterested advocates of their country's progress. In those days a railway was not a profitable speculation, and offered no inducement to the interest of the stock exchange.

But with the patent and continued success of the railway system, matters changed completely. City capitalists saw in railway shares the possibility of a large and immediate return for outlay, and as inventors came forward more and more shares were issued, and at rapidly increasing prices. Those who had taken shares in the first railways had done so because a railway seemed to them a useful and even a necessary aid to commercial progress and prosperity, and naturally, as sensible business men, they looked to receive some direct pecuniary profit on their investment. In a far different spirit the shares of 1844 and 1845 were bought and sold and sold again. The investors of those years had one aim, to make as much money out of their shares as they could, and to make it as rapidly as possible. Whether the particular

line in which they took shares was a necessary one, or was likely to prove useful or profitable in any way, the great mass of investors neither knew nor cared. All they desired was to buy at as low and sell at as high a price as possible. Railway investment, in short, had degenerated into a mere gamble.

The opportunity for gambling brought forth gamblers, and the demand for shares in its turn created an ever-increasing supply. It was now no longer only manufacturers or capitalists who invested; shareholders were not confined to any one or two classes, but all alike, rich and poor, credulous and prudent, city lawyer and village labourer, land-owner, merchant, clergyman, clerk, rushed to join the throng of speculators. In such an atmosphere fraud and cunning throve apace. Parliament, which had let the honest lines of earlier years fight for their lives unhelped, now to its even greater discredit put out no hand to check the orgy of dishonest trafficking. Railway bills were passed in shoals. The projected lines (many of them were never more than projected) might be of broad or narrow gauge, might include any workable or unworkable gradients, might involve a tunnel twenty miles long, might serve the same district as satisfactory existing lines, and even run parallel with such lines, might in fact be precisely what their projectors chose. The Committee passed them, and the barristers pocketed their enormous fees. Not the barristers only, either; all the eminent

engineers of the day were solicited to sell the use of their names to give countenance and support to these wild projects, and many of them were ready enough to do so. In 1844, 48 railway Acts were passed, in 1845 120, and in 1846 272! Egineers were found for all these, some well-known men taking upon themselves the engineering of more than thirty lines in one year.

George Stephenson's downright and unshakable honesty of mind and purpose was never shown more clearly than during these gambling years. With other celebrated engineers he was pressed again and again to allow his name to be used, but he would never consent. The honesty of such a man is to be taken for granted, and has no need of praise, but it rejoiced the hearts of the few among his friends who kept aloof from the mania, and like him recognized it for the unclean thing it was.

The railway mania gave rise to systematic swindling in the construction of new lines, which were formed on a principle as far removed as possible from that adopted by George and Robert Stephenson. The plan which the Stephensons followed was to divide the whole length of the line into portions of from ten to twenty miles long, each of which was put under the superintendence of an assistant engineer, usually a pupil of Stephenson's own. The contractors to whom the line was given over, in the same short lengths, were chosen with great care, and all

materials were provided by the company itself. Every smallest detail of the work was examined and tested stringently, first by the inspectors, usually experienced workmen, and then by the assistant engineers, who, for the sake of their own good name, if for no other reason, would pass no slipshod work on the contractors' part. Finally, the whole line was always directly supervised by the Stephensons themselves, and any attempt at dishonest work was unerringly marked and rectified.

During the speculative years there was neither the will nor the time for any such method. The power of the contractor grew as that of the assistant engineer declined. The line was no longer let in short lengths; sometimes the whole line would be let to one contractor. This alone gave the contractor more power, and also he supplied the materials. The chief engineer was frequently resident only in name, and did not choose to give his full mind and time to one or even two or three lines. Sometimes he was connected with the contractor, so that it was to his interest to allow the contractor to be paid high prices for scamped work or shoddy materials. The assistant engineers and inspectors were inexperienced men, who stood too much in awe of the powerful contractor to refuse to pass his work. The whole system was the vile offspring of dishonesty and cunning.

In connexion with the railway mania, it is worth noting, as a foil to George Stephenson's

life, the remarkable career of George Hudson, known as the Railway King.

Mr Hudson was a draper and bank manager of York. As a successful and influential business man, he was naturally interested in the progress of the York to Leeds line, and when the line was opened in 1839 he was made chairman of the company. He was also at that time Lord Mayor of York. At this stage in his career, Mr Hudson's conduct was public-spirited and prudent, and laid him open to no accusation on the question of honour. He worked hand in hand with Stephenson, who admired him greatly, and with whom indeed he had several outstanding characteristics in common. His courage, industry, self-confidence, and practical sagacity were undoubted.

During Mr Hudson's chairmanship, the company's dividends showed a remarkable improvement, and having been made a director of the North Midland Railway, he effected a like improvement there, and was elected chairman in acknowledgment of his business capacities. He and Stephenson together bought the Durham Junction line, which proved an excellent investment. Soon afterward Mr Hudson himself bought the Brandling Junction line, for him no doubt a still luckier speculation, but unfortunately not an equally honourable one, though that was not found out until later.

In the course of a few years Mr Hudson rose to be chairman of no less than 600 miles

of railway, and in all these lines the shares were at a premium. He was made M.P. for Sunderland, and enjoyed an astounding popularity all over the country. 'The Railway King' in both his actions and his treatment by his adorers was a monarch of no mean pretensions. But his reign, though magnificent, was brief. After 1845 shares suddenly fell, and their holders with them. Amid the general ruin a railway meeting was held in York, and Mr Hudson was asked to account for his many glittering statements and promises. He could make no answer, and his dupes and his confederates alike turned upon him, had a committee appointed to investigate his conduct, discovered how many thousands of shares he had appropriated, and how worthless were those which they themselves had been induced to buy, and promptly and for ever cast down their idol from his throne.

CHAPTER XXIV: *Visits to Belgium and Spain*

BELGIUM was the first European country to follow Britain's example in the matter of railway construction. America had been still quicker to follow the lead; the Baltimore and Ohio Railway, worked partly by motor power and partly by locomotives, was started in 1829, before the Liverpool and Manchester, but beyond supplying locomotive engines Stephenson had no connexion with the railways of the United States. His engines were found thoroughly reliable by American lines; in 1853 Major-General MacNeil stated that their best engines came from England, and that those supplied twenty years before by Stephenson were still in excellent working order. His connexion with Belgian railways was a close one. King Leopold, during his residence in England, had been greatly interested in the development of the railway system, and had examined the first English lines with a view to introducing railways into his own country.

Early in his reign he began to carry out his plan by commanding the survey of a line from Antwerp to Liége. The Belgian Government was not so decidedly convinced as the King of the advantages of railways, and felt some dubiety about sanctioning even this

short single line, which could be constructed for £400,000. However, an Act was passed in 1834, empowering the construction of this and other lines, covering a large part of the country. The large population of Belgium and the presence of good coalfields made railways desirable, while the absence of mountains rendered construction comparatively simple and cheap. Since the construction was undertaken and the funds provided by the State, there was no waste of money, either on the formation of unnecessary lines or on futile Parliamentary discussions, and there was no speculation.

In 1835 Stephenson went to Belgium at the request of King Leopold, to consult with him as to possible improvements on the lines then in course of construction. Stephenson made various suggestions which were adopted. Before his return he was created a Knight of the Order of Leopold.

The first twelve miles of railway were opened in 1835, and by 1844 the whole system was completed, a second Act having been passed in 1837, authorizing several branches and extensions.

In 1837 Stephenson was again invited to Belgium to witness the public opening of the line from Brussels to Ghent. He was present at a public dinner, when he was surprised and pleased to find himself a very important personage, and to see the people pointing him out as the greatest engineer of the day. On the following day he was invited to dine

with the King and Queen at their own table at Laaken, and afterward to accompany them to a public ball in Brussels.

The Belgian railways were at once successful, and in 1845 more than one English company formed for the purpose was given permission to construct other lines in Belgium. One of these was the Sambre and Meuse Company, on behalf of which Stephenson went again to Belgium to inspect the proposed route. He was accompanied by Mr Sopwith, a celebrated geologist, who was already well acquainted with the formation of the district. The line was to pass through a part of the country rich in minerals, containing coal and iron mines and slate and marble quarries. Stephenson naturally was particularly interested in the coal-mines, and the methods of working in use there. On this occasion he was entertained by Belgian engineers at a banquet at Brussels. At one end of the room was a bust of Stephenson, crowned with laurels; the Union Jack was hung in his honour, and best of all, on the centre table, under a triumphal arch, was a model of a locomotive engine, in which Stephenson was pleased and proud to recognize the 'Rocket.'

On the following day he was summoned to a private interview with the King at the palace at Laaken. The King discussed with him various points of interest in connexion with the railway, and then in answer to his questions Stephenson explained the structure of the Belgian coal-fields, and expounded the

influence of the presence of coal on the manufactures of a country.

Later in the year, Stephenson was once more in Belgium, this time examining the route of a railway in West Flanders, projected by an English company.

His next foreign visit, in the same year, was to Spain, where an English company had projected a line from Madrid to the Bay of Biscay. It had been conceded and was being surveyed, but the company was not satisfied with the conditions allowed by the Spanish Government, and Sir Joshua Walmsley was going to Madrid to endeavour to obtain further concessions, chiefly in the way of land and timber. Stephenson accompanied him out of friendship and interest, knowing that his professional assistance would be of value. He gave his services free, except for travelling expenses.

The jonrney was of great interest to Stephenson, who had been little out of England. He was quick to notice anything new in the way of vegetation or methods of agriculture in the districts through which they passed. Still more narrowly did he observe any engineering works. A large chain bridge over the Dordogne attracted particular attention, and he took the trouble to walk across it twice in order to examine its construction more particularly. When he came back to Sir Joshua Walmsley after this closer inspection he said very seriously: "This bridge cannot stand; it is impossible that it can sustain

the necessary pressure. Supposing a large body of troops to march over it, there would be so much oscillation as to cause the greatest danger; in fact, it could not stand." Stepheson was so much impressed by the danger that he wrote a letter of warning to the authorities. Unfortunately nothing was done to improve the structure, and some years later Stephenson's prediction was fulfilled, for when a body of troops was marching across the chains broke, and many of the men were killed.

Stephenson spent ten days making a careful survey of the proposed route. He found that the works involved would be formidable and expensive, and the probable traffic less than had been estimated; the Spanish Government had given no reply to the English company's statement of its terms, although ten days had passed since the final proposal had been made. The whole project seemed unsatisfactory, and as Stephenson's presence in London was necessary on the last day of November, he and Sir Joshua Walmsley began their homeward journey, and travelled as rapidly as possible, day and night. The exhaustion consequent upon Stephenson's trying work of surveying in the mountains had made him unfit for such a journey. Sir Joshua, seeing that he was ill, wished him to rest for a time in Paris, but he insisted on continuing. During the voyage from Havre to Southampton he became much worse, and was found to be suffering from pleurisy. He

was able, however, to dictate letters and reports to Sir Joshua, who showed himself a most devoted and considerate friend. Stephenson recovered from the actual illness, but was never again as hale as before.

CHAPTER XXV : *Quiet Years*

AS has been mentioned already, Stephenson had taken the Clay Cross estate on lease in 1838, at the same time taking up his residence at Tapton House. He had expected that a ready market would be found for the coal in the Midland Counties, but he had not known, or not taken into consideration, that the people of that district had been accustomed to coal of a different type, so that they looked with disfavour on the slower-burning Clay Cross coal. It could not be sent to London for sale very profitably either, owing to the high rate charged for transport on the Midland Railway, so that, to begin with, the venture was not particularly successful.

Nevertheless, in 1841 Stephenson purchased other extensive coal-fields in the neighbourhood, and set up lime-works, for which he used the Clay Cross coal, so that although after 1840 he no longer took an active part in railway engineering, he still found his time fully occupied. Robert Stephenson took his place in that year as engineer of the Midland and York railways, and John Dixon succeeded him on the Chester lines.

Among his interests, one that held a foremost place was the formation of Mechanics' Institutes. He had never forgotten the difficulties with which he himself had had to contend in his early life, when books and

teachers alike were hard to obtain, and he did his best in a private manner to further educational facilities for working men. As early as 1824 he had presided at a public meeting in Newcastle at which it was decided to found a Mechanics' Institute there, and twenty years later he was a constant and honoured visitor to the Institutes at Belper and Chesterfield. In 1841 the cheap means of transit afforded by railways enabled the members of these two Institutes to visit each other, upward of three hundred men representing each Institute. At both these visits Stephenson was present as the most distinguished guest. The old professional jealousy of the trained engineers and mechanics had gradually lessened, and by that time had almost passed away. In his own neighbourhood he was regarded by the mechanics almost with veneration. He was always a bad speaker on a public platform, but with these young men he was at ease, and he enjoyed telling them of his own early struggles and of how he fought his difficulties and overcame them by hard work and determination—ending always by exhorting them likewise to "Persevere!"

At the joint meetings at Chesterfield and Belper he made speeches of this kind, and on both occasions he cordially invited any of the men who had made mechanical inventions to show him their drawings and models, when he would be glad to discuss their ideas and give them advice. He did not foresee the result

of that kindly suggestion. The speeches were published, and soon mechanics, not from Derbyshire only but from all over the country, were besieging him with letters and visits, clamouring to show their inventions—some of them crazy enough. So long as Stephenson was still actively pursuing his own calling, he had little time to spare for considering crack-brained or antiquated inventions, but if a scheme appeared to have any real worth, he never denied it consideration, and after his retirement he gave much time and patience to these applications; and also very often pecuniary assistance. Most of the devices were worthless. One of the inventors who had received a favourable answer from Stephenson, published it in the paper, with the addition of a rhyme by himself in which he referred to the extraordinary number of inventors who wasted Stephenson's time.

One or two, however, were genuine inventors and these were helped forward gladly by Stephenson. One workman who had invented a steam gauge, grateful for the encouragement and advice given to him, asked: "Before I leave, will you be pleased to tell me what is your charge?" "Charge!" was the answer, "Oh! nonsense, I make no charge; but I'll tell you what you must do. Send your instrument down to my works and I'll attach it to one of my boilers and prove it. I will do more: I'll put it in the papers for you, and invite the public to come and examine it at work, and afterward purchase it myself,

if it answers as I expect it will." The invention did answer, and Stephenson published a letter recommending it for use in factories and steamboats.

The last line for which Stephenson was appointed engineer was the Whitehaven and Maryport Railway, John Dixon being appointed in conjunction with him. In the same year he was chairman of the Yarmouth and Norwich Railway, in which he held a large proportion of the shares. The most important event for him in 1844, however, was the opening of the Newcastle and Darlington line. There was now a complete line from London to Newcastle, and on the occasion of the opening Stephenson made the whole journey in about nine hours. The opening was a great event. The whole of Newcastle was on holiday, and at night a banquet was held, at which Stephenson occupied the place of honour. He was introduced by the Hon. Mr Liddell, M.P., son of Lord Ravensworth, Stephenson's early patron. Mr Liddell referred to the opening of the new line, completing the chain from London to Newcastle, by means of which "he had been enabled to take part in the proceedings of the House of Commons at a late hour in the night, and to arrive at Newcastle in time for an early dinner on the following day. This wonderful achievement was the result of the capital, skill, and enterprise of England, and if he felt proud of this new triumph of his country, what must be the feelings of that illustrious

individual now sitting among them, who, though born in humble circumstances, had, by the force of his genius and his industry, so distinguished himself as to hand down the name of Stephenson to everlasting fame! He would not have referred to the position from which Mr Stephenson had sprung, were it not that he himself, so far from being ashamed of his origin, was in the habit of alluding to it, and if Mr Stephenson took a pride in the humility of his birth, surely his countrymen might be proud of the obscurity of his youth, as compared with the prominence of his present position. He was happy to add that, distinguished as he was by his genius and his deeds, his sterling honesty reflected higher honour upon George Stephenson than even those rare abilities with which he was endowed. By the construction of a railway from London to Folkestone and Dover, thousands of persons had been enabled to spend their last Whitsuntide holidays at Calais and Boulogne among their 'natural enemies,' and when such was the case, the two nations would in time be purged of their senseless antipathies, and learn to look upon each other, not as foreigners and foes, but members in common of the great human family. Mr Stephenson, therefore, might be looked upon as the great pacificator of the age. And yet, a few years ago, he was but a working engineman at a colliery!"

Stephenson in his reply related his connexion with locomotives in the form of a brief

autobiography which is worth reading in full for its truth and simplicity, although some of it has been quoted already: "As the honourable member has referred to the engineering efforts of my early days, it may not be amiss if I say a few words to you on that subject, more especially for the encouragement of my younger friends. Mr Liddell has told you that in my early days I worked at an engine at a coal pit. I had then to work early and late, and my employment was a most laborious one. For about twenty years I had often to rise to my labour at one and two o'clok in the morning, and worked until late at night. Time rolled on, and I had the happiness to make some improvements in engine work. The Company will be gratified when I tell them that the first locomotive that I made was at Killingworth Colliery. The owners were pleased with what I had done in the collieries, and I then proposed to make an engine to work upon the smooth rails. It was with Lord Ravensworth's money that my first locomotive was built. Yes, Lord Ravensworth and his partners were the first gentlemen to entrust me with money to make a locomotive. That was more than thirty years ago, and we first called it 'My Lord.' I then stated to some of my friends, now living, that those high velocities with which we are now so familiar would, sooner or later, be attained, and that there was no limit to the speed of such an engine, provided the works could be made to stand; but nobody

would believe me at that time. The engines could perform the high velocities now reached when they were first invented; but, by their superior construction, an immense speed is now capable of being obtained. In what has been done under my management, the credit is only in part my own. Throughout, I have been most ably seconded and assisted by my son. In the early period of my career, and when he was a little boy, I felt how deficient I was in education, and made up my mind that I would put him to a good school. I determined that he should have as liberal a training as I could afford to give him. I was, however, a poor man, and how do you think I managed? I betook myself to mending my neighbours' clocks and watches at night, after my daily labour was done. By this means I saved money, which I put by; and, in course of time, I was thus enabled to give my son a good education. While quite a boy he assisted me, and became a companion to me. He got an appointment as under-viewer at Killingworth, and at nights when we came home we worked together at our engineering. I got leave from my employers to go from Killingworth to lay down a railway at Helton, and next to Darlington for a like purpose; and I finished both railways. After that, I went to Liverpool to plan a line to Manchester. The directors of that undertaking thought ten miles an hour would be a maximum speed for the locomotive engine, and I pledged myself to attain that speed. I said I had no

doubt the locomotive might be made to go much faster, but we had better be moderate at the beginning. The directors said I was quite right, for if, when they went to Parliament, I talked of going at a greater rate than ten miles an hour, I should put a cross on the concern. It was not an easy task for me to keep the engine down to ten miles an hour, but it must be done, and I did my best. I had to place myself in the most unpleasant of all positions—the witness-box of a Parliamentary Committee. I was not long in it, I assure you, before I began to wish for a hole to creep out at. I could not find words to satisfy either the Committee or myself, or even to make them understand my meaning. Some said 'He's a foreigner.' 'No.' others replied, 'he's mad.' But I put up with every rebuff, and went on with my plans, determined not to be put down. Assistance gradually increased; great improvements were made in locomotives; until to-day a train which started from London in the morning, has brought me in the afternoon to my native soil, and enabled me to meet again many faces with which I am familiar, and which I am exceedingly pleased to see once more."

Now that the line from London to Newcastle was at last complete, Stephenson was more than ever anxious to see it pushed north to Berwick. The question was taken up eagerly, but there was another side to it. That was the time at which the enthusiasm for atmospheric railways was at its height. Through

Lord Howick's influence many important landowners in Northumberland advocated the working of the Newcastle to Berwick line by atmospheric tubes instead of locomotives, and Mr Brunel was to be their engineer. The thought of his locomotive engine being ousted from its place in the country of its birth was more than George Stephenson could bear with equanimity, and he determined to stand up once more for the child of his invention. There was no rancour, however, on either side. When Stephenson met Mr Brunel in Newcastle, he shook him first by the collar, as was his way, and then by the hand, demanding of him what business he had north of the Tyne. Mr Brunel gave a friendly answer, and they parted, each bent on a fair fight and no quarter. A public meeting held in Newcastle at the end of the year gave its verdict almost unanimously for the locomotive. The real contest took place in the following year before Parliament, but though it was a hard-fought battle, the victory was for Stephenson and the locomotive engine. There was great rejoicing in Newcastle over the result, especially at Stephenson's own works, where the 800 or more workmen were allowed a holiday; they celebrated the event by marching through the town in a procession headed by a band and gay with flags.

In 1841 Mr Brandling, who had stood by Stephenson in the days of the 'Geordy' safety-lamp controversy, had suggested the building of a high level railway bridge over the Tyne, leading to a central railway terminus near the

Castle. A company was formed, with Robert Stephenson as consulting engineer.

George Stephenson was on the committee of management, and also Mr Hudson, who was later his chief supporter in the fight against the atmospheric party. The Act authorizing the construction of the bridge was passed in 1845, but the fine structure designed by his son was not completed until after Stephenson's death.

CHAPTER XXVI: *Last Years and Death*

THE remainder of Stephenson's life was spent quietly at his house at Tapton. Although after 1845 he took no active part in any engineering project, he never suffered from the difficulty felt by so many hard-working men on retirement, as to what they are to do with all their leisure time. His collieries and lime-works at Cross, to which iron-smelting furnaces had now been added, took up much of his attention, and in conjunction with his friend Mr Binns, who had for long been his secretary and was now manager of the Clay Cross works, he thought out many schemes for improving the standard of life of the work-people there. His own early struggles had given him strong feelings on the subject of education for working men, and he determined to do what he could privately to improve matters in his own works. He employed about fifteen hundred workmen, so that he had some scope in the working out of his plans. A church, a public hall, an institute, and schools were built, and the following scheme was put in practice. Each worker as a condition of his employment at the works was required to pay a fortnightly rate; a married man paid a shilling, a single man eightpence, a boy fivepence, a fortnight,

two pence from each fortnightly contribution being set aside for educational purposes. This compulsory saving brought many excellent returns: 1. Free education in day schools for all the children of the workpeople. 2. Free education in night schools for all the boys and young men desiring instruction. 3. Free access to a Workmen's Institute, with its lectures, reading-room supplied with daily and weekly newspapers, and library of 1,600 volumes. 4. Free medical and surgical attendance to all the workpeople and their families. 5. Relief at the rate of 4s. a week during sickness, and 5s. a week during disablement by accident, to all the workpeople. 6. Free access to a fortnightly dance in the large hall, attended by the workpeople and their families. 7. A band of instrumental music, a drum and fife band, a choral society, and a cricket club, were maintained out of the rate. 8. Between £30 and £40 was yearly granted out of the rate to provide prizes for the best cottage garden vegetables, the competition for which was held three times a year in the Public Hall.

This system worked exceedingly well, and is deserving of some consideration. When it is remembered that at the time of its inception free education by the State did not exist, that trade unionism, though never extinguished, was only flickering feebly in the chill blast of Government hostility, and that, apart from Robert Owen, the Co-operative movement can scarcely be said to have begun

(the Rochdale Pioneers started their society in 1844), we can but feel admiration and respect for the two men who conceived and carried out such a scheme. Stephenson was not an idealist and enthusiast like Robert Owen, nor was he in any deep sense a student of economic questions; all the more honour to him then for such a work. The scheme, doubtless, was not ideal; it had the essential defect of being imposed on the men from outside; but that was not Stephenson's fault. The important fact remains that his workpeople formed a community, not just a mass of isolated individuals. He had based his system on the great principle of mutual aid, and his employees worked with enjoyment for common ends. That was no small achievement. Moreover, his shrewd practical common sense saw to it that his plans were all workable, and his chracteristic thoroughness is seen here as elsewhere.

The situation of Tapton, on the wooded top of a hill, looking across the town of Chesterfield to the Derbyshire hills, had attracted Stephenson, and the neglected condition of the gardens, far from acting as a deterrent to his taking the house, had been rather an inducement, since he could have the enjoyment of altering and improving the place to his own mind. It was some time before he had leisure to attend to his property, but after his retirement he found unending interest and delight in it. Before that time he had a footpath, partly made of stone steps, cut up

the hill-side, and leading from Chesterfield Station to the house. Up this he would challenge his friends to a race, when he was taking them to the house, pleased if he succeeded in reaching the top first, as he often did in spite of years and failing breath.

After the gardens had been brought into order, he gave most of his attention to growing fruits and vegetables. He went back in spirit to the days, thirty years before when his cabbages and leeks had been the wonder of Killingworth. He had ten glass forcing houses with hot-water heating, a new thing at that time, and in these he grew melons, grapes, and pine-apples. His pine-house was sixty-eight feet long, and his great object was to grow pine-apples of a proportionate size. He was very successful. In his lifetime the only man who could beat him was the Duke of Devonshire's gardener, and after the latter's death, when the plants had had time to grow, his pine-apples took the first prize, above the Duke's. His grapes and melons too were unusually fine, particularly the melons. He thought of an ingenious method of relieving the melon-stalks by hanging the fruit in wire-gauze baskets. His cucumbers gave him the most trouble. They were large and good, but do what he would he could not get them to grow straight. In the end he made them grow into glass cylinders, which proved an effectual device, for one day he came striding into the house, carrying a perfectly straight cucumber, and exhibiting it to his guests

with the triumphant remark, "I think I've bothered them noo!"

Once more he had time to go bird-nesting. He could tell the names and habits of all the native birds; no one was allowed to touch the nests in his grounds, but he would go to visit them almost daily, to see how the birds were progressing with their building and house-keeping. Bobby, too old now to work, enjoyed, in a paddock near the house, a retirement as comfortable as his master's. He died in 1845, twenty years old. There were other horses, besides dogs and cows, and his old skill in breeding rabbits was shown again. He remembered how as a boy he had tried to hatch out eggs in a rough incubator. Now at the joiner's workshop that he had built in the grounds he had a proper apparatus made, and the experiment this time was successful.

He had special methods of feeding cattle, and prided himself on his breed. He also tried a way of his own for fattening chickens quickly. They were fed three times a day, and after each meal they were shut up to sleep in darkened boxes. Presumably the chickens did not mind, and certainly they grew fat!

His wife was anxious to keep bees, but though many hives were tried none were successful. Stephenson could not understand this for a long time, but one day, when standing at the foot of the hill, he noticed heavily laden bees trying to rise and fly up

to the hives, and falling back to the grass exhausted. It struck him that the failure of the hives was due to the bees flying down the hill for food, and finding the return journey uphill too much for them with their load. He suggested this explanation to a naturalist friend, who agreed with it, and commended Stephenson's quick observation.

He liked to talk with neighbouring farmers, and often attended their agricultural meetings, where he took a vigorous part in the discussions. Indeed, conversation was both his chief mental stimulus and one of his greatest pleasures. He had never been in the habit of reading, and it was too late to form the habit now. Writing he heartily disliked. But he thoroughly enjoyed a good talk, and his interests were varied enough to find some congenial topic in whatever company he chanced to be. On one occasion he amazed Lord Denman, with whom he had fallen into conversation during a railway journey, by the minuteness of his knowledge of watches and watchmaking: with Emerson he discussed electricity; at a social meeting of railway directors, when one of the party demanded a change of theme from railways, Stephenson told him to choose a subject, and smiled when the man propounded 'birds' nests,' little thinkng what a mine of information he had tapped. With his more intimate friends he loved to talk of his own early life. When going on a railway journey, he would walk along the

train, looking eagerly into every compartment until he saw a 'conversible face.'

Such delight in conversation—it was really conversation, for he could listen as well as talk—made him a very sociable person. He was an excellent host, and his house was seldom without guests. Sometimes they would be young men come to seek his advice. It was freely and kindly given, though any youth with a tendency to dandyism would receive some plain-spoken reproof. One who came with a gold-headed cane was greeted with, "Put by that stick, my man, and then I will speak to you." Another was told: "You will, I hope, excuse me; I am a plain-spoken person, and am sorry to see a nice-looking and rather clever young man like you disfigured with that fine-patterned waistcoat, and all these chains and fang-dangs. If I, sir, had bothered my head with such things when at your age, I would not have been where I am now." Stephenson himself at this time dressed plainly in black, with a white neckcloth. His hair, black in youth, was beautifully white in age. The simplicity of his dress, his upright carriage, the clear fair skin and rosy cheeks, would have made him the model of an English country gentleman, had not his massive forehead and keen grey eyes given to his face a more distinctive and determined character. Humour, shrewdness, and kindliness are written all over it, and strength of will in the mouth.

Other visitors who were always welcome were old friends such as Edward Pease. With

them he would sometimes have what he enjoyed most of all, a 'crowdie night.' Oatmeal and boiling water would be brought in, and Stephenson himself would take the bowl of water between his knees, stir in the oatmeal, and partake of the finished 'crowdie' and milk with all the appetite of his youth. It was these old friends who would sometimes persuade him to sing his favourite "John Anderson my Jo."

Other early friends of humble rank were made equally welcome, and those of them who were needy were helped with money in such a way that their self-respect was not hurt, and they went away pleased both with themselves and with their host. Those who had been guilty of wrong-doing and had brought their poverty on themselves, he would scold well, but with the tears streaming down his cheeks, and they too would be sent away with the wherewithal to start afresh. On his visits to Newcastle, Stephenson never failed to go to Killingworth and seek out such of his old companions as were too poor or too diffident to visit him, walking into their cottage with a hearty "Well, and how's all here to-day?"

The grander friends of more recent years were glad to come to Tapton too. Chief among them were Sir Robert Peel, who had a thoroughgoing admiration for Stephenson's genius and character. It was a long time before Stephenson could be persuaded to pay a return visit to Drayton Manor, Sir Robert

Peel's house. "I have no great ambition," he said, "to mix in fine company, and perhaps should feel out of my place among such high folks." At last, however, early in 1845, he gave in to Sir Robert's kind pressure, enforced as it was by the inducement of meeting scientists and other celebrated men whom he knew already. Stephenson did not long remain tongue-tied in the presence of the 'high folks.' His power of original thought, added to shrewd observation and genial humour, made them glad to listen to his views, though he could not always hold his own with more practised speakers. One morning early, Sir William Follett found him in the garden, evidently deep in thought, and demanded to know what he was thinking about. "Why, Sir William, I am thinking over the argument I had with Buckland last night. I know I am right, and that if I only had the command of words that he has, I'd have beaten him." The lawyer thought this was a case for his help and made Stephenson sit down beside him and explain his views as to the formation of coal, which had been the subject under discussion. When he considered himself to have mastered all the points, Sir William jumped up, saying, "Now I am ready for him." That night Sir Robert Peel brought up the subject again, and the little plot succeeded, for Dr Buckland was completely routed. "What do *you* say, Mr Stephenson?" asked his host. "Why," replied Stephenson, "I will only say, this, that of all the powers

above and under the earth, there seems to me to be no power so great as the gift of the gab!"

During this visit Stephenson, who had recently been much interested in a microscope that some friend had brought him, persuaded his fellow-guests to allow their fingers to be pricked in order that they might examine the movement of the globules as seen under the microscope. He had a theory about that, as he had about most things. His child-like delighted wonder at the marvels revealed by the microscope reminds one of what is told of Darwin, who never lost the impulse to excitement and 'gloating' over such marvels, but still looked at them in old age "with a child's first wonder."

One of his thoughts, since familiar, but original in him, was expressed to Dr Buckland one Sunday as they were standing in front of the house on their return from church, and watching the white steam of a distant train. "Now, Buckland," he said, "I have a poser for you. Can you tell me what is the power that is driving the train?" "Well," said Dr Buckland, "I suppose it is one of your big engines." "But what drives the engine?" "Oh, very likely a canny Newcastle driver." "What do you say to the light of the sun?" suggested Stephenson. "How can that be?" "It is nothing else; it is light bottled up in the earth for tens of thousands of years—light, absorbed by plants and vegetables, being necessary for the condensation of carbon during the process of their growth,

if it be not carbon in another form—and now, after being buried in the earth for long ages in fields of coal, that latent light is again brought forth and liberated, made to work, as in that locomotive, for great human purposes."

In 1847 Stephenson was again at Drayton Manor, to take part in the opening ceremony of the Trent Valley Railway, which he had planned. The triumph of the railway system was celebrated on this occasion by Members of Parliament, landed proprietors, and county magnates, men drawn from the classes that had shown themselves twenty years before its bitterest opponents. The speech of the day was made by Sir Robert Peel, who amused his hearers by a reference to Julius Agricola, who, 2000 years ago, as joint engineer and contractor, had formed the first direct line of communication between London and Chester, though with unfavourable gradients! Stephenson in replying once more gave expression to his own disapproval of the broad gauge and to his recommendation of low levels in preference to the direct line with steep gradients, which was suitable enough for Julius Agricola!

Stephenson still continued occasionally to invent improvements in engines and carriages, notably a self-acting brake.

The last railway meeting at which Stephenson was present took place in Manchester, for the purpose of presenting a testimonial to Mr Westhead, the former chairman of the Manchester and Birmingham Railway. Stephenson was duly recognized by all the speakers

as the father of railway enterprise—"the rock from which they had been hewn," to quote Mr Westhead's words.

Toward the end of 1847 he made one more appearance in public, at a social meeting of the Leeds Mechanics' Institute, when he addressed the young mechanics, once again exhorting them to persevere.

Early in 1848 the interesting meeting with Emerson took place. Stephenson was invited to the house of his former pupil, Mr Swanwick, to meet Emerson, and they had not been long in the same room before Stephenson, attracted by this most 'conversible' face, jumped up and shook Emerson by the collar, in his usual way, asking him how it was that in England we could always tell an American. They talked on a variety of subjects, and Stephenson ended, as was his wont, by giving a brief but vivid account of his own life. Emerson said of him that he had in him the lives of many men, and that "it was worth crossing the Atlantic to have seen Stephenson alone; he had such native force of character and vigour of intellect."

Stephenson had never completely recovered from the attack of pleurisy following on his visit to Spain, and for some time he had been in failing health. He kept up all his interests, nevertheless, and even read a paper on *The Fallacies of the Rotatory Engine*, in July 1848, to the members of the Birmingham Institute. Shortly afterward he became ill, and he died suddenly on the 12th of August, 1848, aged sixty-seven.

He was buried in Trinity Church, Chesterfield. On the day of his funeral the shops in Chesterfield were closed, and many of the townspeople, along with most of his own workpeople, joined in the funeral procession. By his workmen he was sincerely mourned.

At the time of his death a statue by Gibson, which the Liverpool and Manchester and Grand Junction Railways had commissioned, was on its way to England. It was placed in St George's Hall, Liverpool. Another statue of him was placed in Euston Square, London, in front of the London and North-Western station. The subscription for it was started by the Society of Mechanical Engineers, which Stephenson had founded, and a large part of the money was subscribed by workingmen. A third statue stands outside Central Station, Newcastle.

The offer of knighthood was made to Stephenson more than once during the Premiership of his friend Sir Robert Peel, but such honours had no lustre for him. He was once asked by some one who wished to dedicate a book to him, what were his 'ornamental initials,' and replied, "I have to state that I have no flourishes to my name, either before or after; and I think it will be as well you merely say 'George Stephenson.' It is true I am a Belgian Knight, but I do not wish to have any use made of it." An office which he did accept with pleasure was that of President of the Institution of Mechanical Engineers of Birmingham.

and simplicity helped him to take his place easily in any society, whether he "dined in mines among miners, or with kings and queens," and all alike found him an interesting and lovable companion. He brought out the best in the men he had to deal with by expecting good of them. He was no fool, to be gulled by a rogue, but he went on the principle of trusting a man until he was proved dishonest, and he found that the principle answered.

His generosity was not confined to money matters, but showed itself in his ever-ready praise of his assistants, and his invariable hearty acknowledgment of their good work, at the opening of a new line. He was always ready to take their part and to stand by them, even to the extent of handing in his own resignation if he considered them unjustly treated.

Above all, he was honest. He could 'stake his head' that any work of his was thoroughly done, and would stand the test of time.

Visitors to the Yorkshire dales often pause beside the little church at Gillamoor to admire the surprise view of the moors and the winding road, and some of them, perhaps, may turn aside into the churchyard and read the stone to the memory of James Smith, mason: "He was a sound workman, and consequently selected to rebuild the chapel." James Smith's church, "finished with his own

hands," remains a landmark far along th
dale, testifying to his thoroughness; hi
epitaph, the finest surely that a man coul
have, might stand for that of many a
unremembered toiler, but it applies with peculia
fitness to George Stephenson, for all his life
in all that he did, he was a "sound workman."

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